

NATIONAL BUREAU OF STANDARDS REPORT

6902

on
Interlaboratory Intercomparisons
of
400-Watt Mercury Vapor Lamps

by
Velma I. Burns
Photometry and Colorimetry Section
Metrology Division



U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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Interlaboratory Intercomparisons
of
400-Watt Mercury Vapor Lamps

Abstract

Two groups of six 400-watt mercury vapor lamps were measured by each of seven laboratories. One group consists of six HILS clear bulb lamps; the other group consists of six HILB/W phosphor-coated lamps. The lamps were operated on a commercial ballast GE #89G164. Five of the laboratories, in addition, operated the lamps on an ASA reference ballast and two of the laboratories reported values for operation on their regular laboratory ballast. Measurements of lumens, lamp current, lamp volts, lamp watts, and lumens per watt were reported for operation of each lamp at 118 line volts and at 400 watts on ballast GE #89G164, and at 240 line volts on the ASA reference ballast. Similar measurements on their regular laboratory ballast were made by two laboratories. The results of the measurements made by the individual laboratories and an analysis of the results are given in this report.

I. Measurements

This intercomparison was undertaken to determine the uniformity of measurements on 400-watt mercury vapor lamps made at the participating laboratories. The laboratories participating and the order of reading are as follows:

- I. General Electric
- II. National Bureau of Standards
- III. Electrical Testing Laboratories
- IV. Westinghouse
- V. Duro Test
- VI. Sylvania
- VII. Champion.

The order in which the laboratories made their measurements was chosen to reduce shipment of the lamps as much as possible. Each laboratory made measurements on both groups of lamps using GE ballast #89G164 while holding the line voltage constant at 118 volts. A second set of measurements was made while holding the lamp watts constant at 400 watts. Five of the laboratories then used an ASA reference ballast (53.4 ohms impedance at 3.2 amperes, and 7-8% power factor) at 240 line volts. Two of the laboratories made additional measurements using their regular ballast. For each method of operation the following quantities were measured: lumens, lamp volts, lamp current, and lamp watts. Each laboratory followed its own customary procedure in making the measurements. The results of all the reported measurements are given in the tables which follow.

Table 1.

Lumens
HILS Mercury Lamps
GE Ballast #89G164, 118 line volts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
A-1	19290	19100	20400	19690	19310	19800	19800	19627
A-2	19030	18800	20100	19650	19180	19680	19510	19421
A-3	19120	18800	20000	19370	19140	19500	19450	19340
A-4	19075	18900	20100	19653	19340	19580	19390	19434
A-5	18950	18700	19900	19443	19130	19420	19370	19273
A-6	<u>19763</u>	<u>19700</u>	<u>20800</u>	<u>20400</u>	<u>19920</u>	<u>20420</u>	<u>20350</u>	<u>20193</u>
ave.	19205	19000	20200	19701	19337	19733	19645	19546
Δ	-341	-546	+654	+155	-209	+187	+ 99	
% Δ	-1.7%	-2.8%	+3.3%	+ .8%	-1.1%	+1.0%	+ .5%	

Table 2.

Lumens
HILB/W Mercury Lamps
GE Ballast #89G164, 118 line volts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
B-1	19830	19600	20300	20617	20210	20480	20200	20177
B-2	20120	19800	20400	20750	20320	20500	20450	20334
B-3	19770	19400	20000	20190	19715	19720	19750	19792
B-4	19445	19000	19700	19683	19370	19520	19800	19503
B-5	20895	20700	21400	21590	20995	21360	21700	21234
B-6	<u>20333</u>	<u>20200</u>	<u>20500</u>	<u>20780</u>	<u>20210</u>	<u>20460</u>	<u>20550</u>	<u>20433</u>
ave.	20066	19783	20383	20602	20137	20340	20408	20246
Δ	-180	-463	+137	+356	-109	+ 94	+162	
% Δ	- .9%	-2.3%	+ .7%	+1.8%	- .5%	+ .5%	+ .8%	

Table 3.

Lumens
HILS Mercury Lamps
GE Ballast #89G164, 400 watts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
A-1	19125	19100	19400	19683	19070	19700	19620	19385
A-2	19000	19100	19300	19767	19000	19660	19510	19334
A-3	18995	18800	19200	19400	19100	19340	19050	19126
A-4	18975	18900	19200	19700	19010	19580	19180	19221
A-5	18935	18800	19100	19533	18800	19540	19110	19117
A-6	<u>19880</u>	<u>19800</u>	<u>20200</u>	<u>20483</u>	<u>18810</u>	<u>20600</u>	<u>20200</u>	<u>19996</u>
ave.	19152	19083	19400	19761	18965	19737	19445	19363
Δ	-211	-280	+ 37	+398	-398	+374	+ 82	
% Δ	-1.1%	-1.4%	+ .2%	+2.1%	-2.1%	+1.9%	+ .4%	

Table 4.

Lumens
HILB/W Mercury Lamps
GE Ballast #89G164, 400 watts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
B-1	19940	19700	20000	20633	20220	20260	20010	20109
B-2	20240	19900	20200	20783	20500	20340	20150	20302
B-3	20000	19700	20100	20252	20100	19900	19600	19950
B-4	19620	19300	19500	19800	19570	19640	19440	19553
B-5	20995	20800	21100	21600	21140	21360	21420	21202
B-6	<u>20553</u>	<u>20300</u>	<u>20400</u>	<u>20833</u>	<u>20600</u>	<u>20620</u>	<u>20300</u>	<u>20515</u>
ave.	20225	19950	20217	20650	20355	20353	20153	20272
Δ	- 47	-322	- 55	+388	+ 83	+ 81	-119	
% Δ	- .2%	-1.6%	- .3%	+1.9%	+ .4%	+ .4%	- .6%	

Table 5.

Lamp Volts
HILS Mercury Lamps
GE Ballast #89G164, 118 line volts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
A-1	135.1	133	136.3	134	135.4	135.5	133.5	134.7
A-2	130.8	129	131.8	132	130.5	131.0	132.1	131.0
A-3	136.8	136	137.9	137	136.7	137.0	136.9	136.9
A-4	138.3	138	139.3	138	138.1	138.0	138.2	138.3
A-5	134.9	134	136.1	134	135.2	134.5	134.9	134.8
A-6	<u>127.9</u>	<u>127</u>	<u>129.0</u>	<u>129</u>	<u>127.8</u>	<u>128.0</u>	<u>128.0</u>	<u>128.1</u>
ave.	134.0	132.8	135.1	134.0	134.0	134.0	133.9	134.0
Δ	0	- 1.2	+ 1.1	0	0	0	- .1	
% Δ	0	- .9%	+ .8%	0	0	0	- .1%	

Table 6.

Lamp Volts
HILB/W Mercury Lamps
GE Ballast #89G164, 118 line volts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
B-1	134.6	134	136.0	134	134.7	135.0	134.0	134.6
B-2	133.9	133	135.2	134	133.8	134.5	133.8	134.0
B-3	127.1	126	128.2	126	125.5	127.0	127.2	126.7
B-4	130.0	129	131.3	130	130.7	130.0	130.0	130.1
B-5	131.6	130	132.7	131	131.7	131.5	131.7	131.5
B-6	<u>128.3</u>	<u>126</u>	<u>129.3</u>	<u>128</u>	<u>128.6</u>	<u>128.5</u>	<u>129.9</u>	<u>128.4</u>
ave.	130.9	129.7	132.1	130.5	130.8	131.1	131.1	130.9
Δ	0	- 1.2	+ 1.2	- .4	- .1	+ .2	+ .2	
% Δ	0	- .9%	+ .9%	- .3%	- .1%	+ .2%	+ .2%	

Table 7.

Lamp Volts
HILS Mercury Lamps
GE Ballast #89G164, 400 watts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
A-1	135.0	134	136.3	135	135.2	135.5	133.5	134.9
A-2	130.7	130	131.6	132	130.2	131.0	132.2	131.1
A-3	136.8	136	137.7	136	136.5	137.0	136.9	136.7
A-4	138.2	137	139.1	138	137.8	138.0	138.2	138.0
A-5	134.9	134	136.0	134	134.7	134.5	134.8	134.7
A-6	<u>127.9</u>	<u>127</u>	<u>128.9</u>	<u>129</u>	<u>127.7</u>	<u>128.0</u>	<u>128.0</u>	<u>128.1</u>
ave.	133.9	133.0	134.9	134.0	133.7	134.0	133.9	133.9
△	0	-.9	+1.0	+ .1	-.2	+.1	0	
% △	0	-.7%	+ .7%	+ .1%	-.1%	+ .1%	0	

Table 8.

Lamp Volts
HILB/W Mercury Lamps
GE Ballast #89G164, 400 Watts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
B-1	134.6	134	135.9	134	134.7	134.5	133.9	134.5
B-2	133.9	133	135.1	134	133.7	134.5	133.8	134.0
B-3	127.4	126	128.0	126	127.4	127.0	127.3	127.0
B-4	130.0	128	131.2	130	130.2	130.0	130.0	129.9
B-5	131.7	130	132.4	131	131.7	131.5	131.8	131.4
B-6	<u>128.5</u>	<u>127</u>	<u>129.2</u>	<u>128</u>	<u>128.2</u>	<u>128.5</u>	<u>129.9</u>	<u>128.5</u>
ave.	131.0	129.7	132.0	130.5	131.0	131.0	131.1	130.9
△	+.1	-1.2	+1.1	-.4	+.1	+.1	+.2	
% △	+.1%	-.9%	+.8%	-.3%	+.1%	+.1%	+.2%	

Table 9.
Lamp Current (amperes)
HILS Mercury Lamps
GE Ballast #89G164, 118 line volts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
A-1	3.19	3.18	3.10	3.20	3.17	3.19	3.28	3.187
A-2	3.28	3.28	3.23	3.24	3.28	3.28	3.30	3.270
A-3	3.15	3.14	3.11	3.14	3.15	3.17	3.20	3.151
A-4	3.11	3.12	3.08	3.11	3.14	3.12	3.17	3.121
A-5	3.18	3.18	3.14	3.20	3.19	3.18	3.23	3.186
A-6	<u>3.34</u>	<u>3.36</u>	<u>3.30</u>	<u>3.30</u>	<u>3.35</u>	<u>3.33</u>	<u>3.38</u>	<u>3.337</u>
ave.	3.21	3.21	3.16	3.20	3.21	3.21	3.26	3.209
△	+0.001	+0.001	-.049	-.009	+0.001	+0.001	+0.051	
% △	+0.03%	+0.03%	-1.5%	-.3%	+0.03%	+0.03%	+1.6%	

Table 10.
Lamp Current (amperes)
HILB/W Mercury Lamps
GE Ballast #89G164, 118 line volts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
B-1	3.18	3.18	3.14	3.20	3.16	3.22	3.25	3.190
B-2	3.20	3.21	3.17	3.20	3.17	3.22	3.25	3.203
B-3	3.34	3.34	3.30	3.37	3.35	3.36	3.39	3.350
B-4	3.28	3.27	3.24	3.28	3.24	3.28	3.36	3.279
B-5	3.24	3.26	3.21	3.28	3.21	3.27	3.32	3.256
B-6	<u>3.31</u>	<u>3.34</u>	<u>3.27</u>	<u>3.30</u>	<u>3.27</u>	<u>3.32</u>	<u>3.35</u>	<u>3.309</u>
ave.	3.26	3.27	3.22	3.27	3.23	3.28	3.32	3.264
△	-.004	+0.006	-.044	+0.006	-.034	+0.016	+0.056	
% △	-.1%	+ .2%	-1.3%	+ .2%	-1.0%	+ .5%	+1.7%	

Table 11.

Lamp Current (Amperes)
HILS Mercury Lamps
GE Ballast #89G164, 400 watts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
A-1	3.18	3.18	3.10	3.20	3.16	3.18	3.26	3.180
A-2	3.29	3.31	3.21	3.25	3.26	3.29	3.28	3.270
A-3	3.14	3.14	3.07	3.15	3.13	3.14	3.16	3.133
A-4	3.10	3.12	3.03	3.12	3.08	3.12	3.13	3.100
A-5	3.19	3.20	3.09	3.20	3.16	3.21	3.21	3.180
A-6	<u>3.36</u>	<u>3.40</u>	<u>3.27</u>	<u>3.32</u>	<u>3.34</u>	<u>3.35</u>	<u>3.35</u>	<u>3.341</u>
ave.	3.21	3.22	3.13	3.21	3.19	3.22	3.23	3.201
△	+0.009	+0.019	-0.071	+0.009	-0.011	+0.019	+0.029	
% △	+0.3%	+0.6%	-2.2%	+0.3%	-0.3%	+0.6%	+0.9%	

Table 12.

Lamp Current (Amperes)
HILB/W Mercury Lamps
GE Ballast #89G164, 400 watts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
B-1	3.19	3.22	3.12	3.20	3.18	3.20	3.24	3.193
B-2	3.21	3.24	3.13	3.20	3.19	3.21	3.23	3.201
B-3	3.37	3.38	3.32	3.37	3.36	3.38	3.38	3.366
B-4	3.29	3.33	3.22	3.29	3.26	3.30	3.32	3.287
B-5	3.26	3.27	3.18	3.27	3.23	3.27	3.29	3.253
B-6	<u>3.34</u>	<u>3.35</u>	<u>3.25</u>	<u>3.31</u>	<u>3.32</u>	<u>3.33</u>	<u>3.32</u>	<u>3.317</u>
ave.	3.28	3.30	3.20	3.27	3.26	3.28	3.30	3.270
△	+0.01	+0.03	-0.07	0	-0.01	+0.01	+0.03	
% △	+0.3%	+0.9%	-2.1%	0%	-0.3%	+0.3%	+0.9%	

Table 13.

Lamp Watts
HILS Mercury Lamps
GE Ballast #89G164, 118 line volts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
A-1	402	400	409	399	401	401	400.4	401.8
A-2	399	397	404	399	401	399	401.2	400.0
A-3	401	399	407	399	403	403	401.8	402.0
A-4	401	401	404	399	403	400	405.2	401.9
A-5	399	398	401	399	402	399	400.2	400.2
A-6	<u>396</u>	<u>398</u>	<u>401</u>	<u>399</u>	<u>401</u>	<u>396</u>	<u>399.2</u>	<u>398.6</u>
ave.	399.7	398.8	404.8	399.0	402	399.7	401.3	400.8
△	-1.1	-2.0	+ 4.0	-1.8	+ 1.2	-1.1	+ .5	
% △	-.3%	-.5%	+1.0%	-.4%	+ .3%	-.3%	+ .1%	

Table 14.

Lamp Watts
HILB/W Mercury Lamps
GE Ballast #89G164, 118 line volts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
B-1	398	398	403	400	399	403	399.8	400.1
B-2	397	398	401	399	398	401	401.6	399.4
B-3	394	395	398	399	393	398	399.4	396.6
B-4	396	396	401	399	394	398	401.8	398.0
B-5	397	398	402	399	397	400	402.4	399.3
B-6	<u>395</u>	<u>399</u>	<u>401</u>	<u>399</u>	<u>394</u>	<u>397</u>	<u>399.6</u>	<u>397.8</u>
ave.	396.2	397.3	401.0	399.2	395.8	399.5	400.8	398.5
△	- 2.3	-1.2	+ 2.5	+ .7	- 2.7	+ 1.0	+ 2.3	
% △	-.6%	-.3%	+ .6%	+ .2%	-.7%	+ .3%	+ .6%	

Table 15.

Lumens per Watt
HILS Mercury Lamps
GE Ballast #89G164, 118 line volts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
A-1	48.0	47.8	49.9	49.3	48.2	49.4	49.5	48.87
A-2	47.7	47.4	49.8	49.3	47.8	49.3	48.7	48.57
A-3	47.7	47.1	49.1	48.7	47.5	48.4	48.4	48.13
A-4	47.6	47.1	49.8	49.2	48.0	49.0	47.8	48.36
A-5	47.5	47.0	49.3	48.7	47.6	48.7	48.4	48.17
A-6	<u>49.9</u>	<u>49.5</u>	<u>51.9</u>	<u>51.0</u>	<u>49.7</u>	<u>51.6</u>	<u>51.6</u>	<u>50.74</u>
ave.	48.1	47.6	50.0	49.4	48.1	49.4	49.1	48.81
△	- .71	-1.21	+1.19	+ .59	- .71	+ .59	+ .29	
% △	-1.5%	-2.5%	+2.4%	+1.2%	-1.5%	+1.2%	+ .6%	

Table 16.

Lumens per Watt
HILB/W Mercury Lamps
GE Ballast #89G164 118 line volts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
B-1	49.8	49.2	50.4	51.6	50.7	50.8	50.6	50.44
B-2	50.7	49.7	50.9	52.0	51.1	51.1	51.0	50.93
B-3	50.2	49.1	50.3	50.7	50.2	49.5	49.5	49.93
B-4	49.1	48.0	49.1	49.3	49.2	49.0	49.3	49.00
B-5	52.6	52.0	53.2	54.0	52.9	53.4	54.0	53.16
B-6	<u>51.5</u>	<u>50.6</u>	<u>51.1</u>	<u>52.0</u>	<u>51.3</u>	<u>51.5</u>	<u>51.4</u>	<u>51.31</u>
ave.	50.7	49.8	50.8	51.6	50.9	50.9	51.0	50.80
△	- .1	-1.0	0	+ .8	+ .1	+ .1	+ .2	
% △	- .2%	-2.0%	0%	+1.6%	+ .2%	+ .2%	+ .4%	

Table 17.

Lumens per Watt
HILS Mercury Lamps
GE Ballast #89G164, 400 watts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
A-1	47.8	47.8	48.5	49.2	47.7	49.3	49.1	48.49
A-2	47.5	47.8	48.2	49.4	47.5	49.2	48.8	48.34
A-3	47.5	47.0	48.0	48.5	47.8	48.4	47.6	47.83
A-4	47.4	47.2	48.0	49.4	47.5	49.0	47.9	48.06
A-5	47.3	47.0	47.8	48.8	47.0	48.9	47.8	47.80
A-6	<u>49.7</u>	<u>49.5</u>	<u>50.5</u>	<u>51.2</u>	<u>47.0</u>	<u>51.5</u>	<u>50.5</u>	<u>49.99</u>
ave.	47.9	47.7	48.5	49.4	47.4	49.4	48.6	48.42
\triangle	- .52	- .72	+ .08	+ .98	-1.02	+ .98	+ .18	
% \triangle	-1.1%	-1.5%	+ .2%	+2.0%	-2.1%	+2.0%	+ .4%	

Table 18.

Lumens per Watt
HILB/W Mercury Lamps
GE Ballast #89G164, 400 watts

Lamp No.	GE	NBS	ETL	West.	Duro T.	Syl.	Champ.	Ave.
B-1	49.8	49.2	50.0	51.6	50.6	50.7	50.0	50.27
B-2	50.6	49.8	50.5	52.0	51.2	50.9	50.2	50.74
B-3	50.0	49.2	50.2	50.6	50.2	49.8	49.0	49.86
B-4	49.0	48.2	48.8	49.5	48.9	49.1	48.6	48.87
B-5	52.5	52.0	52.8	54.0	52.8	53.4	53.5	53.00
B-6	<u>51.4</u>	<u>50.8</u>	<u>51.0</u>	<u>52.1</u>	<u>51.5</u>	<u>51.6</u>	<u>50.8</u>	<u>51.31</u>
ave.	50.6	49.9	50.5	51.6	50.9	50.9	50.3	50.68
\triangle	- .08	- .78	- .18	+ .92	+ .22	+ .22	- .38	
% \triangle	- .2%	-1.5%	- .4%	+1.8%	+ .4%	+ .4%	- .7%	

Table 19.

Lumens
HILS Mercury Lamps
ASA Reference Ballast, 240 line volts

Lamp No.	GE	ETL	West.	Duro T.	Syl.	Ave.
A-1	19228	19400	19190	19450	19400	19334
A-2	18853	19000	18900	19110	18980	18969
A-3	19285	19300	18920	19400	18940	19169
A-4	19128	19400	19160	19480	19200	19274
A-5	18997	19100	18880	19200	18760	18987
A-6	<u>19593</u>	<u>19800</u>	<u>19590</u>	<u>19600</u>	<u>19620</u>	<u>19641</u>
ave.	19181	19333	19107	19373	19150	19229
Δ	- 48	+ 104	- 122	+ 144	- 79	
% Δ	- .2%	+ .5%	- .6%	+ .7%	- .4%	

Table 20.

Lumens
HILB/W Mercury Lamps
ASA Reference Ballast, 240 line volts

Lamp No.	GE	ETL	West.	Duro T.	Syl.	Ave.
B-1	19953	20300	19975	20460	19680	20074
B-2	20140	20400	20065	20600	19800	20201
B-3	19697	19600	19490	19860	19180	19565
B-4	19587	19400	19180	19620	18960	19349
B-5	20813	21100	20980	21340	20720	20991
B-6	<u>20153</u>	<u>20200</u>	<u>20085</u>	<u>20290</u>	<u>19780</u>	<u>20102</u>
ave.	20057	20167	19963	20362	19687	20047
Δ	+ 10	+ 120	- 84	+ 315	- 360	
% Δ	+ .05%	+ .6%	- .4%	+1.6%	-1.8%	

Table 21.

Lamp Volts
HILS Mercury Lamps
ASA Reference Ballast, 240 line volts

Lamp No.	GE	ETL	West.	Duro T.	Syl.	Ave.
A-1	135.0	136.2	136	135.1	135	135.5
A-2	130.5	131.3	130	129.8	130	130.3
A-3	136.8	138.0	136	136.9	137	136.9
A-4	138.3	139.3	138	137.8	138	138.3
A-5	134.7	136.3	134	132.2	135	134.4
A-6	<u>127.6</u>	<u>128.7</u>	<u>128</u>	<u>126.7</u>	<u>127</u>	<u>127.6</u>
ave.	133.8	135.0	133.7	133.1	133.7	133.8
Δ	0	+ 1.2	- .1	- .7	- .1	
% Δ	0	+ .9%	- .1%	- .5%	- .1%	

Table 22.

Lamp Volts
HILB/W Mercury Lamps
ASA Reference Ballast, 240 line volts

Lamp No.	GE	ETL	West.	Duro T.	Syl.	Ave.
B-1	134.2	135.8	134	133.9	134	134.4
B-2	133.8	135.2	134	133.7	134	134.1
B-3	127.0	128.3	126	126.2	126	126.7
B-4	129.5	131.2	130	129.7	130	130.1
B-5	131.3	132.7	131	131.2	131	131.4
B-6	<u>128.0</u>	<u>129.3</u>	<u>128</u>	<u>127.7</u>	<u>128</u>	<u>128.2</u>
ave.	130.6	132.1	130.5	130.4	130.5	130.8
Δ	- .2	+ 1.3	- .3	- .4	- .3	
% Δ	- .2%	+ 1.0%	- .2%	- .3%	- .2%	

Table 23.

Lamp Current (Amperes)
HILS Mercury Lamps
ASA Reference Ballast, 240 line volts

Lamp No.	GE	ETL	West.	Duro T.	Syl.	Ave.
A-1	3.18	3.13	3.14	3.20	3.12	3.154
A-2	3.26	3.21	3.22	3.27	3.20	3.232
A-3	3.14	3.12	3.11	3.17	3.09	3.126
A-4	3.11	3.09	3.09	3.14	3.07	3.100
A-5	3.18	3.15	3.15	3.20	3.11	3.158
A-6	<u>3.31</u>	<u>3.27</u>	<u>3.29</u>	<u>3.33</u>	<u>3.23</u>	<u>3.286</u>
ave.	3.20	3.16	3.17	3.22	3.14	3.176
△	+ .024	-.016	-.006	+ .044	-.036	
% △	+ .8%	- .5%	- .2%	+1.4%	-1.1%	

Table 24.

Lamp Current (Amperes)
HILB/W Mercury Lamps
ASA Reference Ballast, 240 line volts

Lamp No.	GE	ETL	West.	Duro T.	Syl.	Ave.
B-1	3.19	3.13	3.17	3.22	3.12	3.166
B-2	3.19	3.17	3.17	3.22	3.14	3.178
B-3	3.32	3.28	3.29	3.34	3.29	3.304
B-4	3.27	3.23	3.22	3.28	3.22	3.244
B-5	3.24	3.21	3.21	3.26	3.20	3.224
B-6	<u>3.29</u>	<u>3.27</u>	<u>3.28</u>	<u>3.31</u>	<u>3.24</u>	<u>3.274</u>
ave.	3.25	3.21	3.22	3.27	3.20	3.232
△	+ .018	-.022	-.012	+ .038	-.032	
% △	+ .6%	- .7%	- .4%	+1.2%	-1.0%	

Table 25.

Lamp Watts
HILS Mercury Lamps
ASA Reference Ballast, 240 line volts

Lamp No.	GE	ETL	West.	Duro T.	Syl.	Ave.
A-1	402	406	391	402	393	398.8
A-2	399	400	389	399	387	394.8
A-3	402	408	395	403	394	400.4
A-4	403	410	393	403	394	400.6
A-5	400	406	391	399	390	397.2
A-6	<u>395</u>	<u>399</u>	<u>388</u>	<u>393</u>	<u>384</u>	<u>391.8</u>
ave.	400	405	391	400	390	397.3
△	+2.7	+7.7	-6.3	+2.7	-7.3	
% △	+ .7%	+1.9%	-1.6%	+ .7%	-1.8%	

Table 26.

Lamps Watts
HILB/W Mercury Lamps
ASA Reference Ballast, 240 line volts

Lamp No.	GE	ETL	West.	Duro T.	Syl.	Ave.
B-1	401	405	391	401	391	397.8
B-2	399	405	390	399	390	396.6
B-3	394	399	388	392	389	392.4
B-4	396	401	389	396	389	394.2
B-5	398	404	391	399	391	396.6
B-6	<u>394</u>	<u>401</u>	<u>389</u>	<u>395</u>	<u>386</u>	<u>393.0</u>
ave.	397	402	390	397	389	395.1
△	+1.9	+6.9	-5.1	+1.9	-6.1	
% △	+ .5%	+1.7%	-1.3%	+ .5%	-1.5%	

Table 27.

Lumens per Watt
HILS Mercury Lamps
ASA Reference Ballast, 240 line volts

Lamp No.	GE	ETL	West.	Duro T.	Syl.	Ave.
A-1	47.8	47.8	49.1	48.4	49.4	48.50
A-2	47.3	47.5	48.6	47.9	49.0	48.06
A-3	48.0	47.3	48.0	48.1	48.1	47.90
A-4	47.5	47.3	48.8	48.3	48.8	48.14
A-5	47.5	47.0	48.3	48.1	48.1	47.80
A-6	<u>49.6</u>	<u>49.6</u>	<u>50.5</u>	<u>49.9</u>	<u>51.1</u>	<u>50.14</u>
ave.	47.95	47.75	48.9	48.4	49.1	48.42
△	- .47	- .67	+ .48	- .02	+ .68	
% △	-1.0%	-1.4%	+1.0%	- .04%	+1.4%	

Table 28.

Lumens per Watt
HILB/W Mercury Lamps
ASA Reference Ballast 240 line volts

Lamp No.	GE	ETL	West.	Duro T.	Syl.	Ave.
B-1	49.8	50.1	51.1	51.0	50.3	50.46
B-2	50.5	50.4	51.5	51.6	50.8	50.96
B-3	50.0	49.1	50.3	50.7	49.3	49.88
B-4	49.5	48.4	49.0	49.5	48.9	49.06
B-5	52.3	52.2	53.7	53.5	53.1	52.96
B-6	<u>51.1</u>	<u>50.4</u>	<u>51.7</u>	<u>51.4</u>	<u>51.3</u>	<u>51.18</u>
ave.	50.5	50.1	51.2	51.3	50.6	50.75
△	- .25	- .65	+ .45	+ .55	- .15	
% △	- .5%	-1.3%	+ .9%	+1.1%	- .3%	

Table 29.

Lumens
Regular Laboratory Ballast, 400 Watts

HILS Mercury Lamps

HILB/W Mercury Lamps

Lamp No.	NBS	GE		Lamp No.	NBS	GE	
A-1	19100	19380		B-1	19700	20257	
A-2	18800	19103		B-2	20000	20497	
A-3	18800	19505		B-3	19800	20367	
A-4	18800	19210		B-4	19400	20267	
A-5	18900	19320		B-5	20800	21135	
A-6	<u>19800</u>	<u>19960</u>		B-6	<u>20300</u>	<u>20923</u>	
ave.	19033	19413	19223		20000	20574	20287

Table 30.

Lamp Volts
Regular Laboratory Ballast, 400 Watts

HILS Mercury Lamps

HILB/W Mercury Lamps

Lamp No.	NBS	GE		Lamp No.	NBS	GE	
A-1	134	134.7		B-1	134	134.2	
A-2	128	130.6		B-2	133	134.0	
A-3	136	136.5		B-3	126	127.3	
A-4	136	138.5		B-4	129	130.0	
A-5	134	134.6		B-5	130	131.4	
A-6	<u>127</u>	<u>128.0</u>		B-6	<u>127</u>	<u>128.0</u>	
ave.	132.5	133.8	133.2		129.8	130.8	130.3

Table 31.

Lamp Current (Amperes)
Regular Laboratory Ballast, 400 Watts

HILS Mercury Lamps

HILB/W Mercury Lamps

Lamp No.	NBS	GE		Lamp No.	NBS	GE	
A-1	3.18	3.18		B-1	3.20	3.19	
A-2	3.32	3.29		B-2	3.24	3.21	
A-3	3.15	3.14		B-3	3.40	3.37	
A-4	3.13	3.09		B-4	3.32	3.30	
A-5	3.22	3.19		B-5	3.28	3.26	
A-6	<u>3.38</u>	<u>3.35</u>		B-6	<u>3.36</u>	<u>3.35</u>	
ave.	3.23	3.21	3.22		3.30	3.28	3.29

Table 32.

GE Measurements Using Regular Laboratory
Ballast at 208 Line Volts

Lamp No.	Lamp Volts	Lamp Amperes	Lamp Watts	Lumens
A-1	135.1	3.27	412	20210
A-2	131.0	3.37	413	19957
A-3	136.9	3.22	410	20175
A-4	139.0	3.16	408	19760
A-5	135.0	3.27	410	20030
A-6	<u>128.5</u>	<u>3.45</u>	<u>415</u>	<u>20950</u>
ave.	134.3	3.29	411	20180
B-1	134.8	3.28	411	20953
B-2	134.0	3.29	410	21125
B-3	127.8	3.47	413	21193
B-4	130.3	3.38	412	20987
B-5	132.0	3.35	412	21980
B-6	<u>128.7</u>	<u>3.43</u>	<u>414</u>	<u>21777</u>
ave.	131.3	3.37	412	21336

III Analysis of the Results

An analysis of the results of the measurements has been made following a modification of the method described by W. J. Youden (1), (2), (3). This modified method is described in National Bureau of Standards Reports No. 6605 "Interlaboratory Intercomparisons of 32-Watt T10 Cool-White Circline Lamps" and No. 6698 "Interlaboratory Intercomparisons of 40-Watt T12 Cool White Fluorescent Lamps".

(1) Graphical Diagnosis of Interlaboratory Test Results, Industrial Quality Control. Vol. XV No. 11, May 1959.

(2) Product Specifications and Test Procedures, Industrial and Engineering Chemistry. Vol. 50, page 91A, October 1958.

(3) Circumstances Alter the Cases, Industrial and Engineering Chemistry. Vol. 50, page 77A, December 1958.

Lumens
Differences from the Averages
HILS Mercury Vapor Lamps
GE Ballast #89G164 at 118 Line Volts

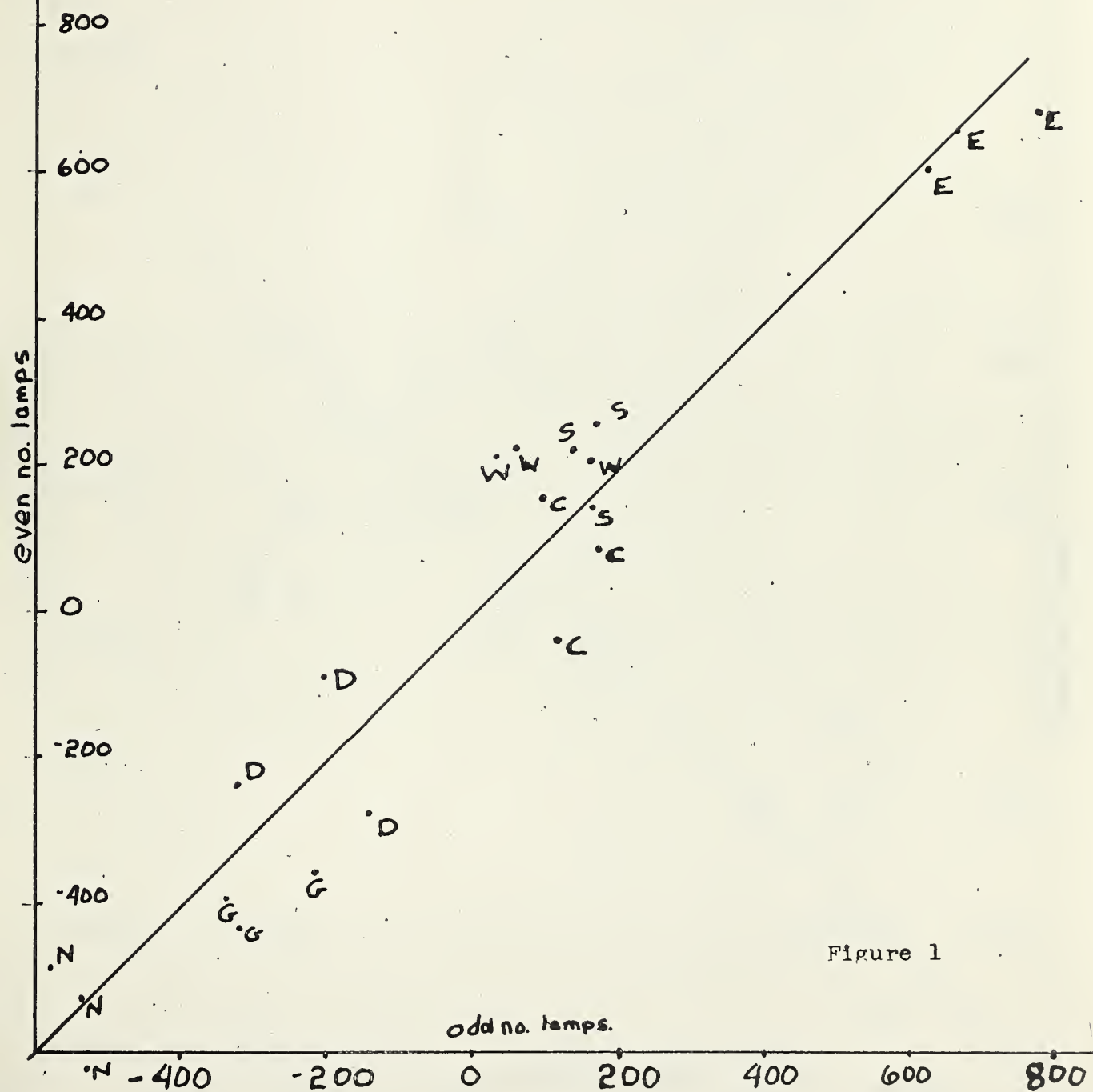


Figure 1

Lumens
Differences from the Averages
HILB/W Mercury Vapor Lamps
GE Ballast #89G164 at 118 Line Volts

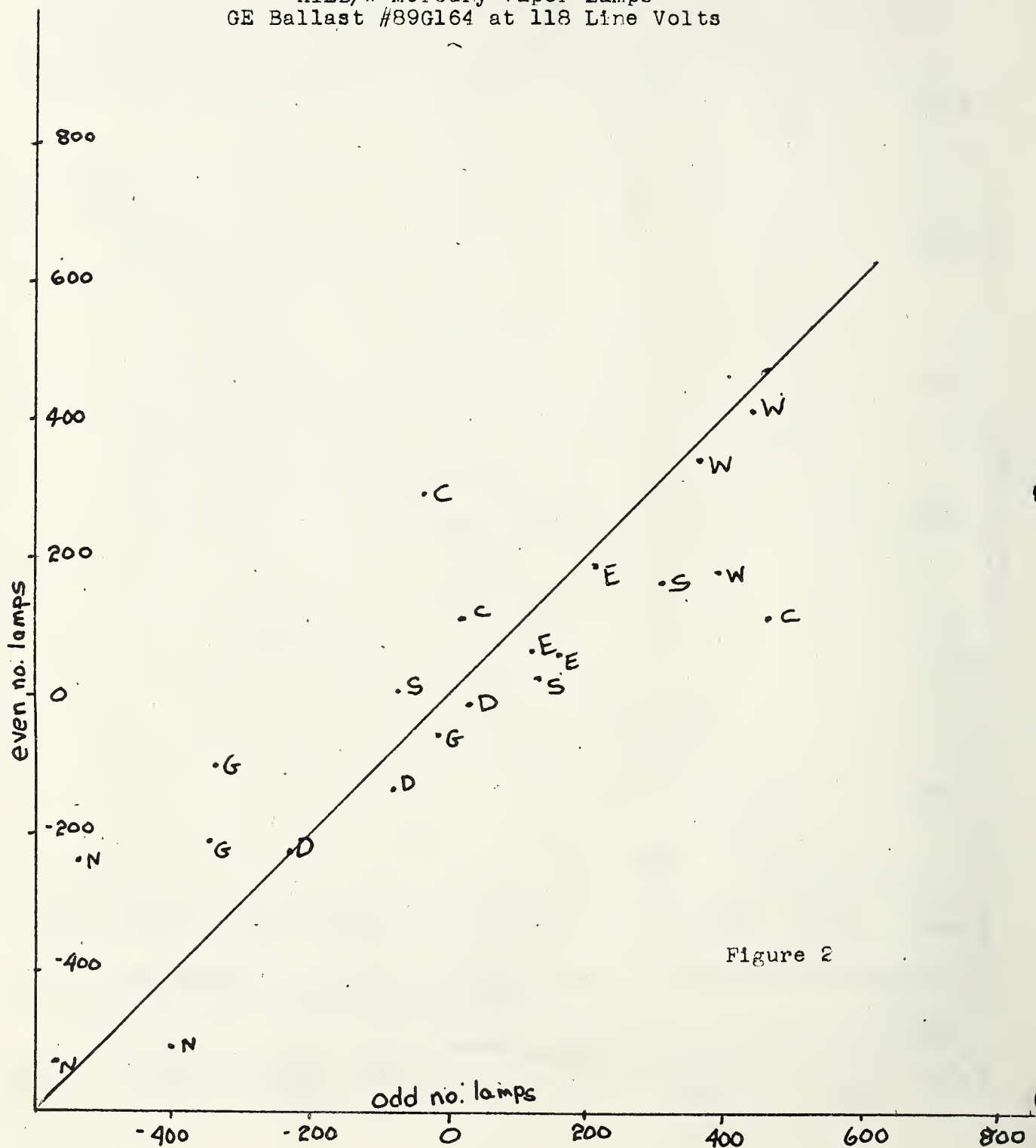


Figure 2

Lumens
Differences from the Averages
HILS Mercury Vapor Lamps
GE Ballast #89G164 at 400 Watts

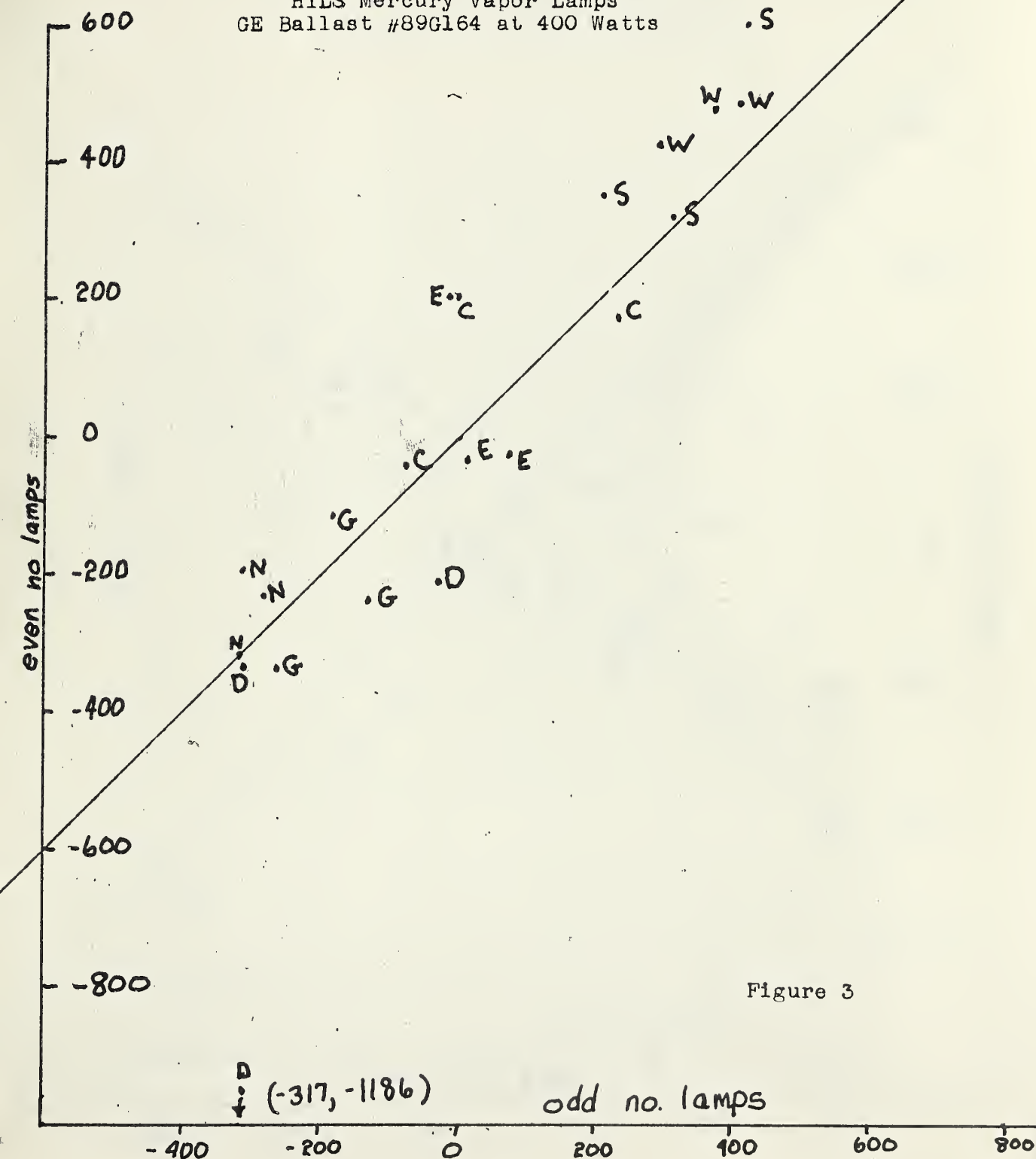


Figure 3

Lumens
Differences from the Averages
HILB/W Mercury Vapor Lamps
GE Ballast #89G164 at 400 Watts

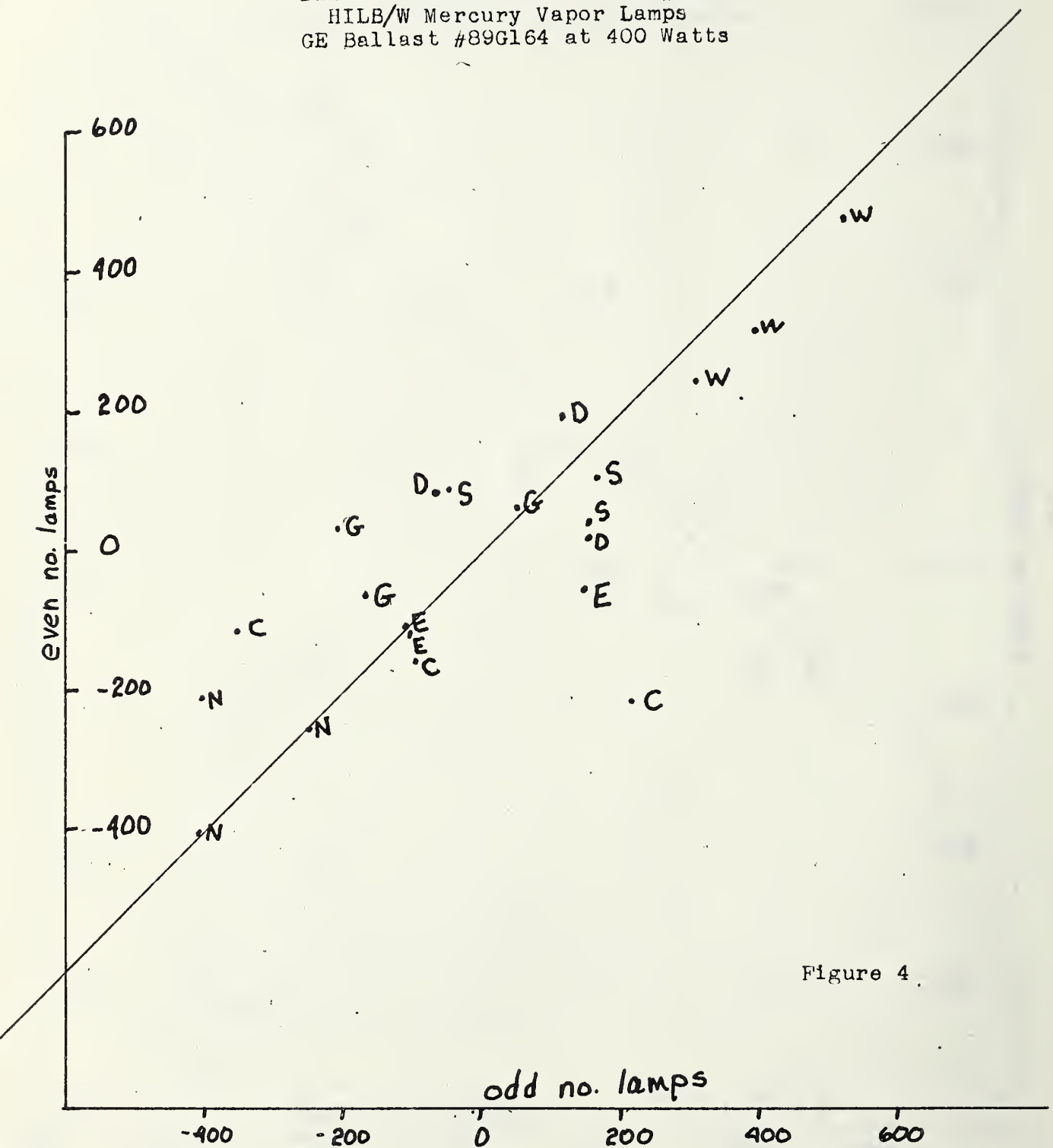


Figure 4

Lamp Volts
Differences from the Averages
HILS Mercury Vapor Lamp
GE Ballast #89G164 at 118 Line Volts

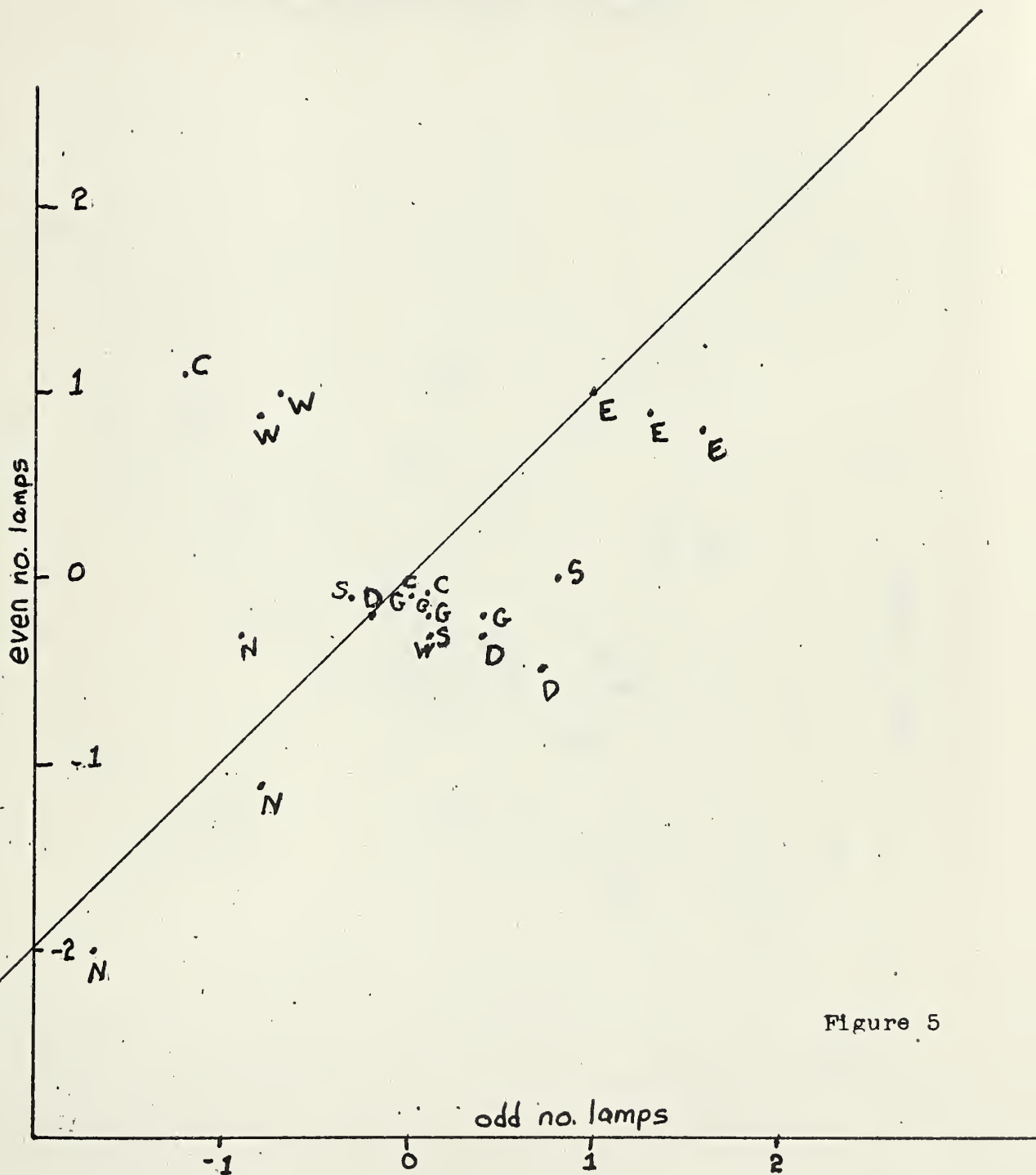


Figure 5

Lamp Volts
Differences from the Averages
HILB/W Mercury Vapor Lamps
GE Ballast #89G164 at 118 Line Volts

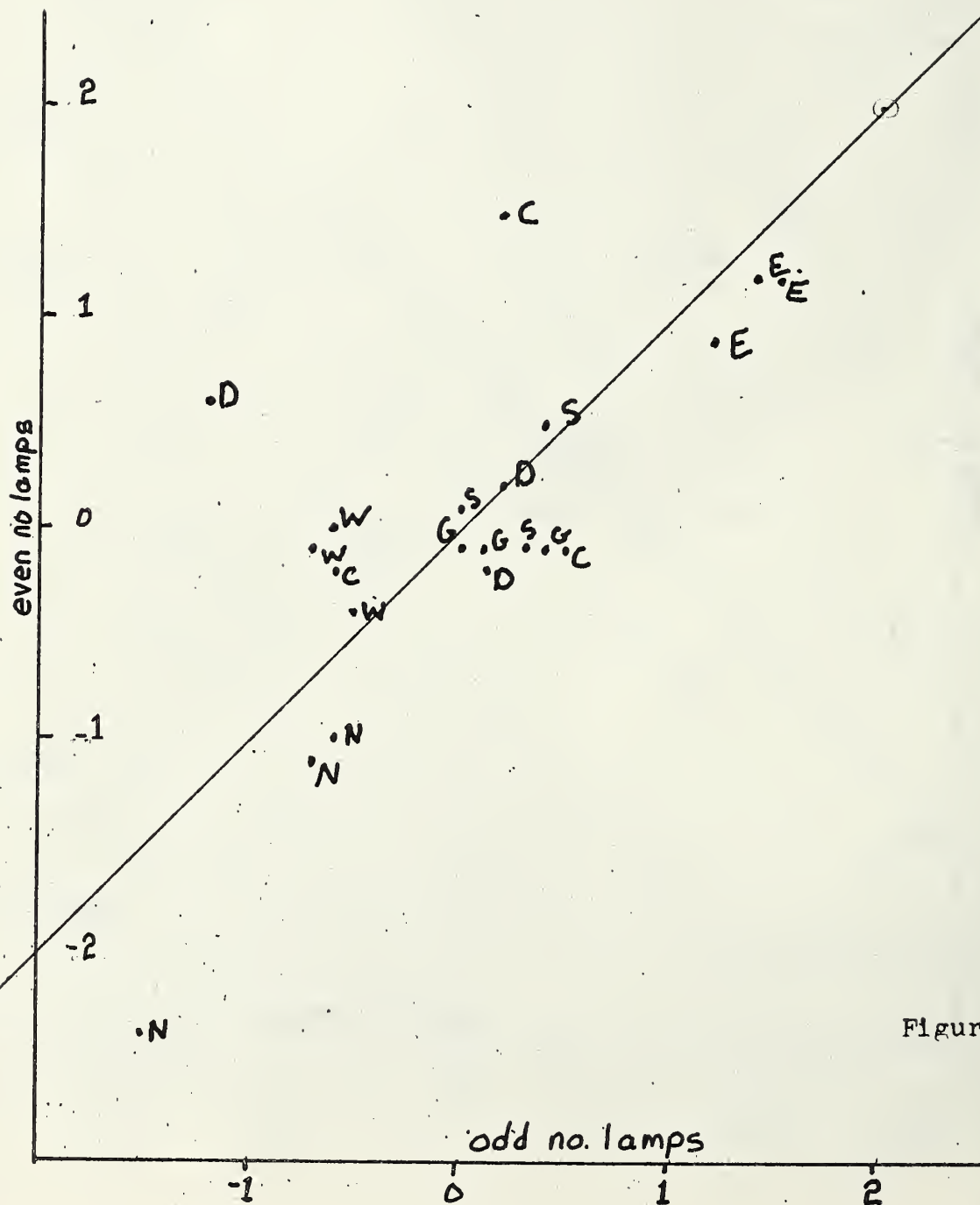


Figure 6

Lamp Volts
Differences from the Averages
HILS Mercury Vapor Lamps
GE Ballast #89G164 at 400 Watts

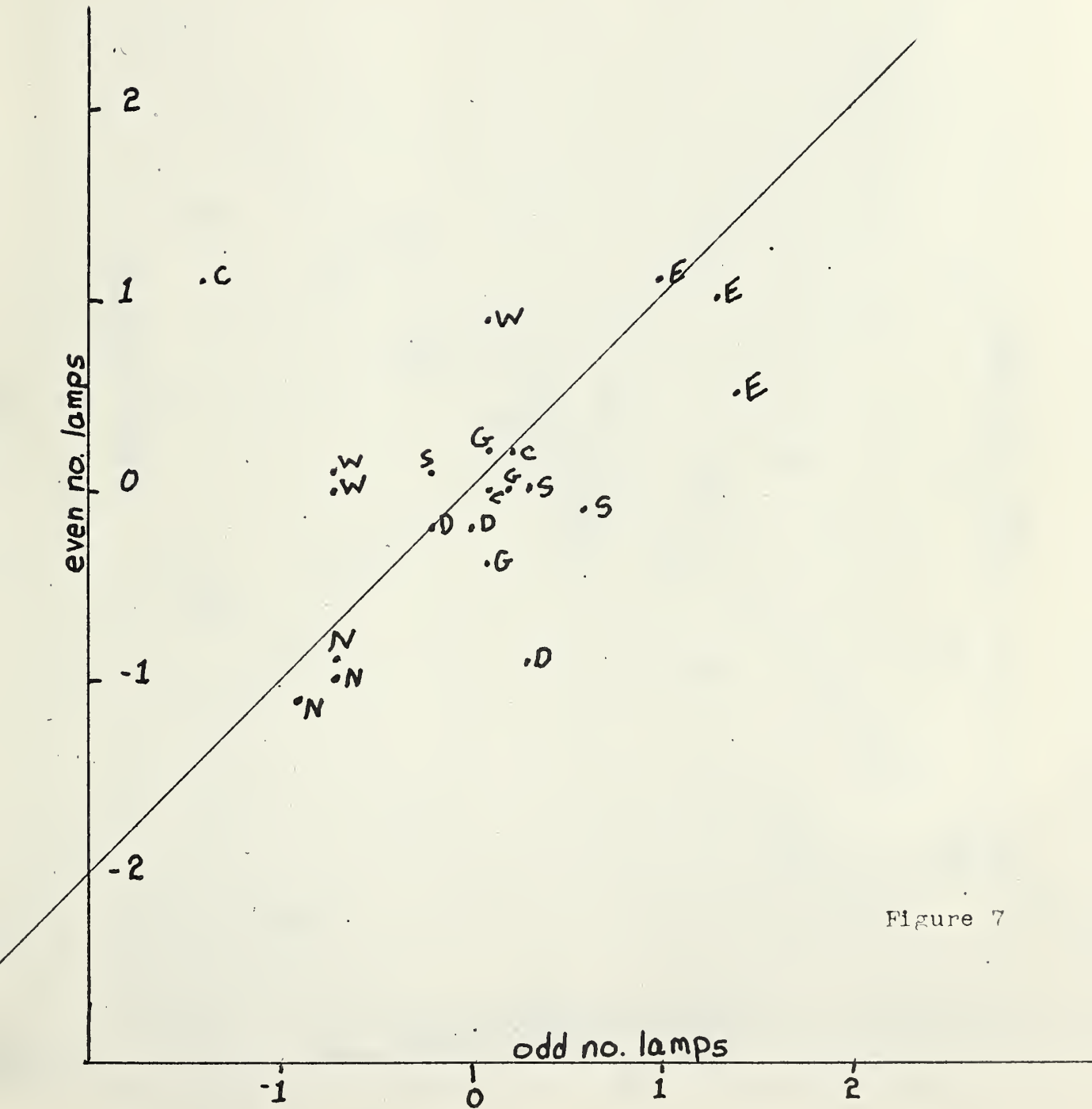


Figure 7

Lamp Volts
Differences from the Averages
HILB/W Mercury Vapor Lamps
GE Ballast #89G164 at 400 Watts

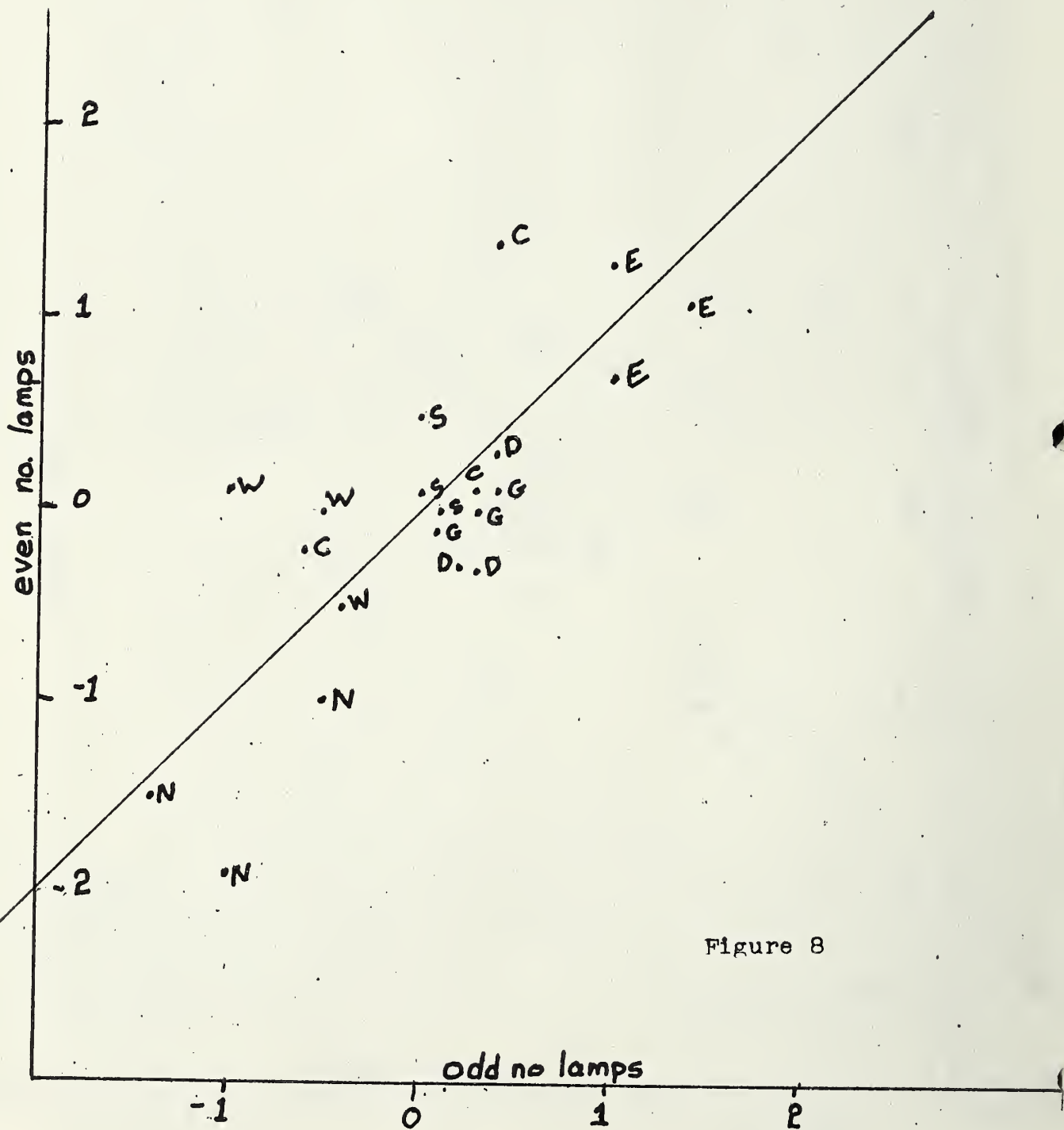


Figure 8

Amperes
Differences from the Averages
HILS Mercury Vapor Lamps
GE Ballast #89G164 at 118 Line Volts

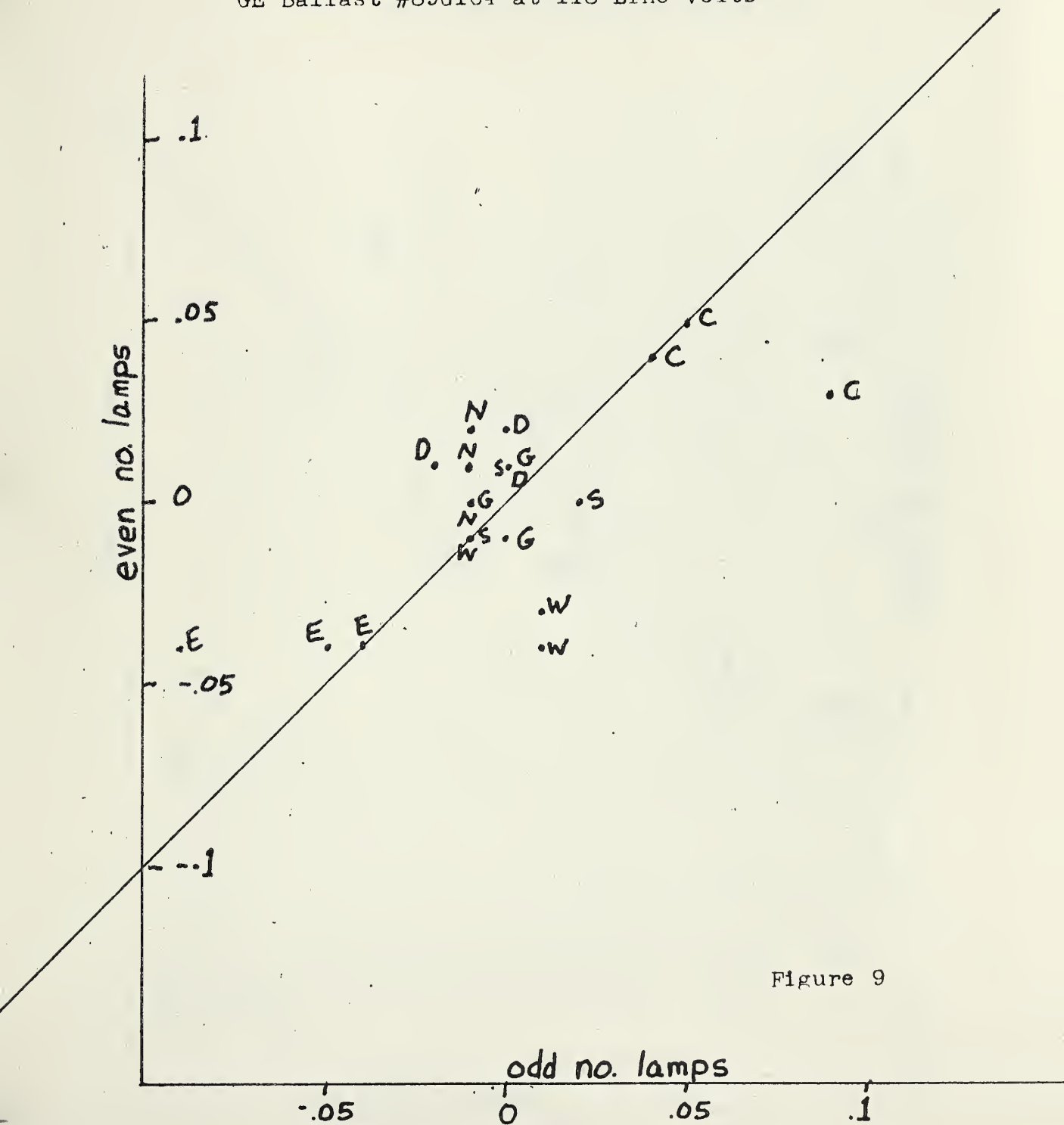


Figure 9

Amperes
 Differences from the Averages
 HILB/W Mercury Vapor Lamps
 GE Ballast #89G164 at 118 Line Volts

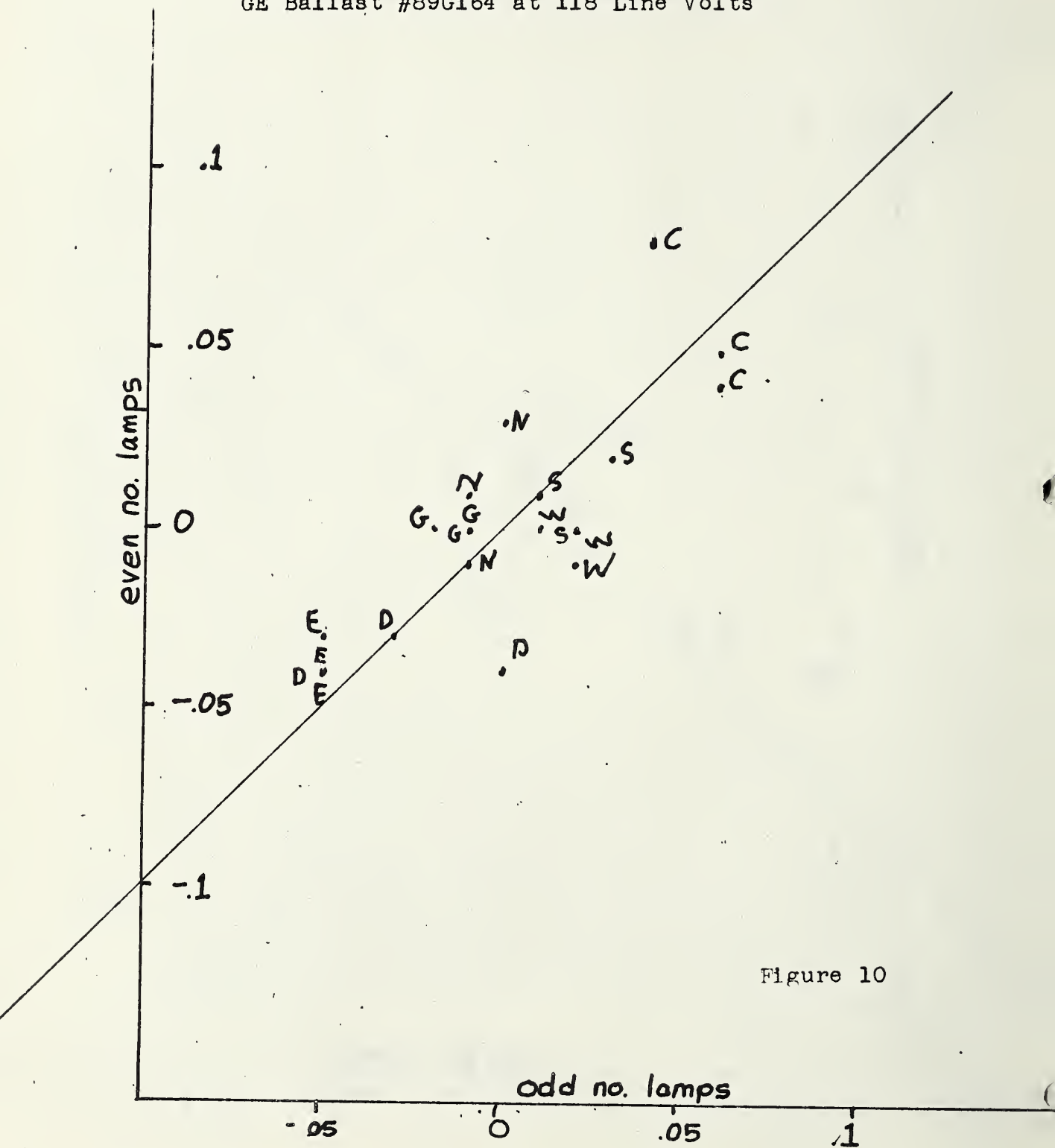


Figure 10

Amperes
 Differences from the Averages
 HILS Mercury Vapor Lamps
 GE Ballast #89G164 at 400 Watts

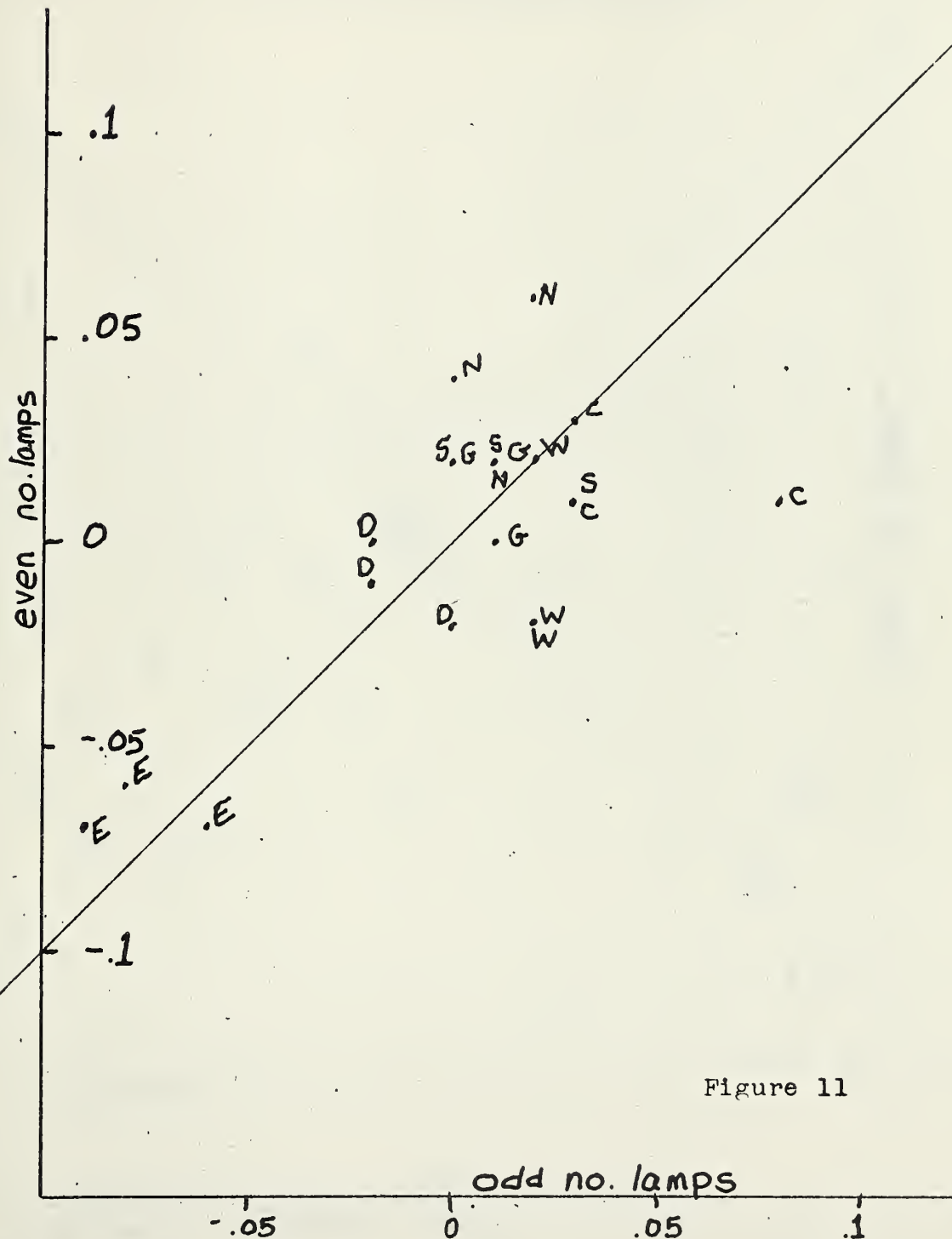


Figure 11

Amperes
Differences from the Averages
HILB/W Mercury Vapor Lamps
GE Ballast #89G164 at 400 Watts

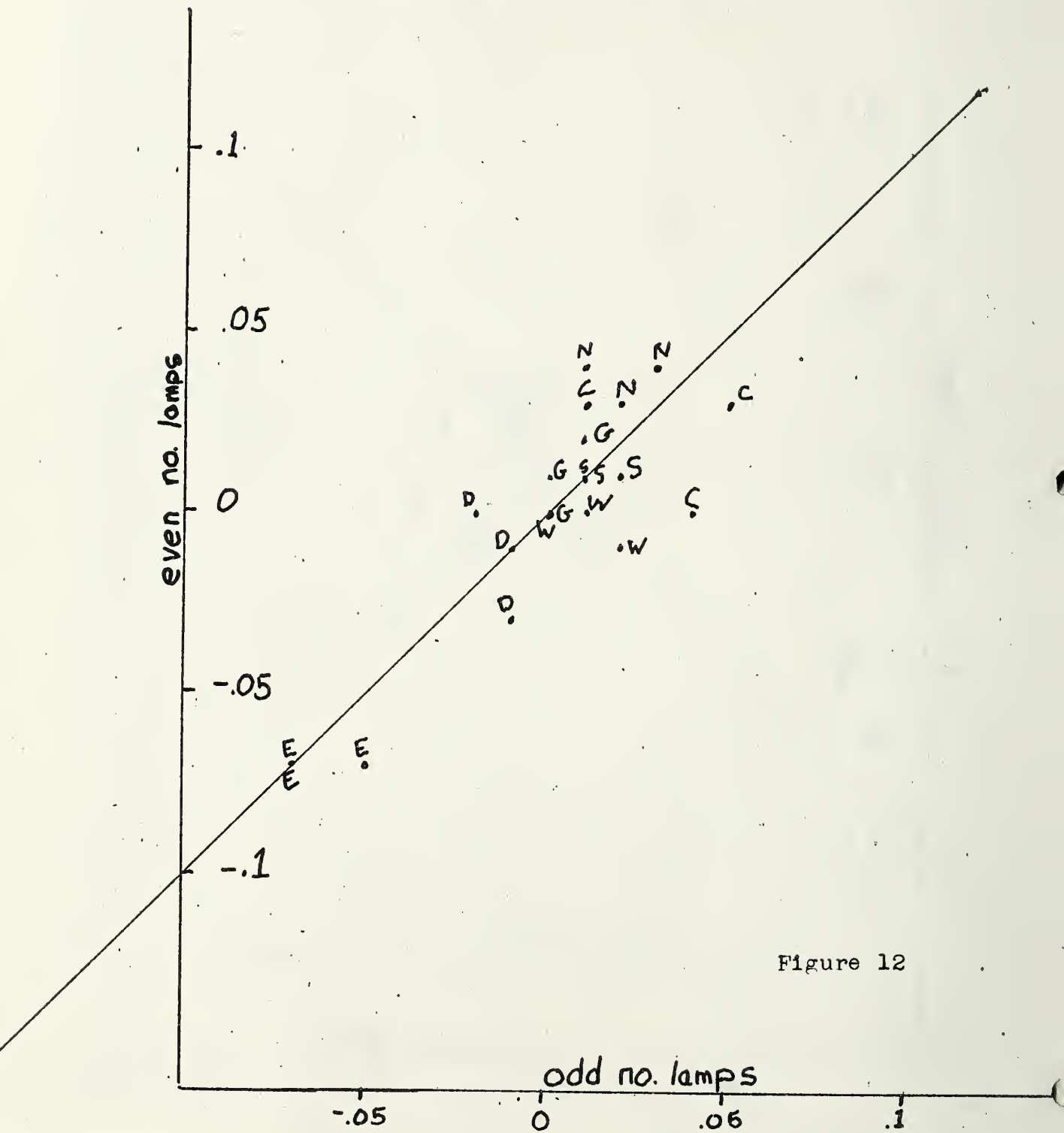


Figure 12

Watts
 Differences from the Averages
 HILS Mercury Vapor Lamps
 GE Ballast #89G164 at 118 Line Volts

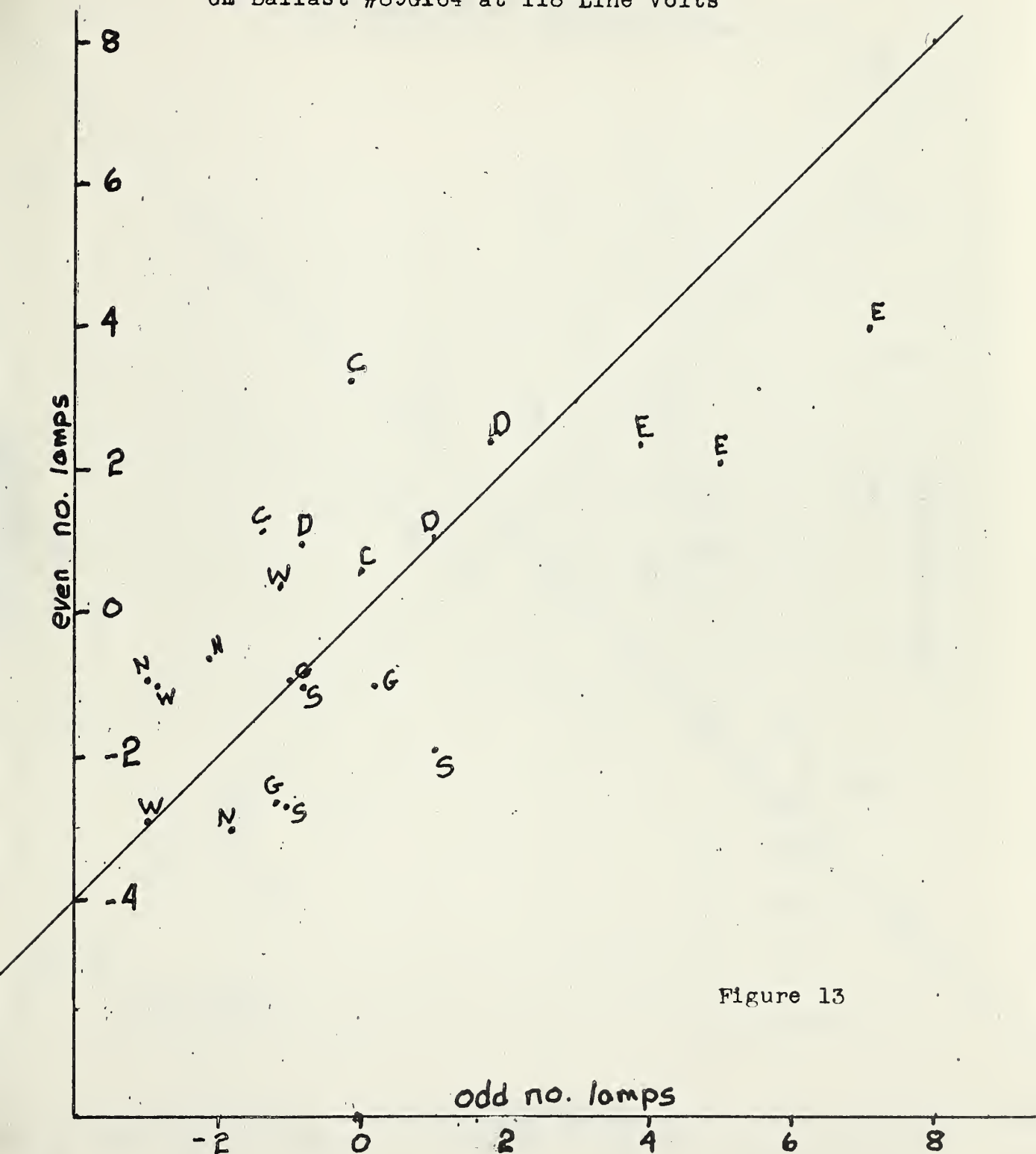


Figure 13

Watts /
 Differences from the Averages
 HILB/W Mercury Vapor Lamps
 GE Ballast #89G164 at 118 Line Volts

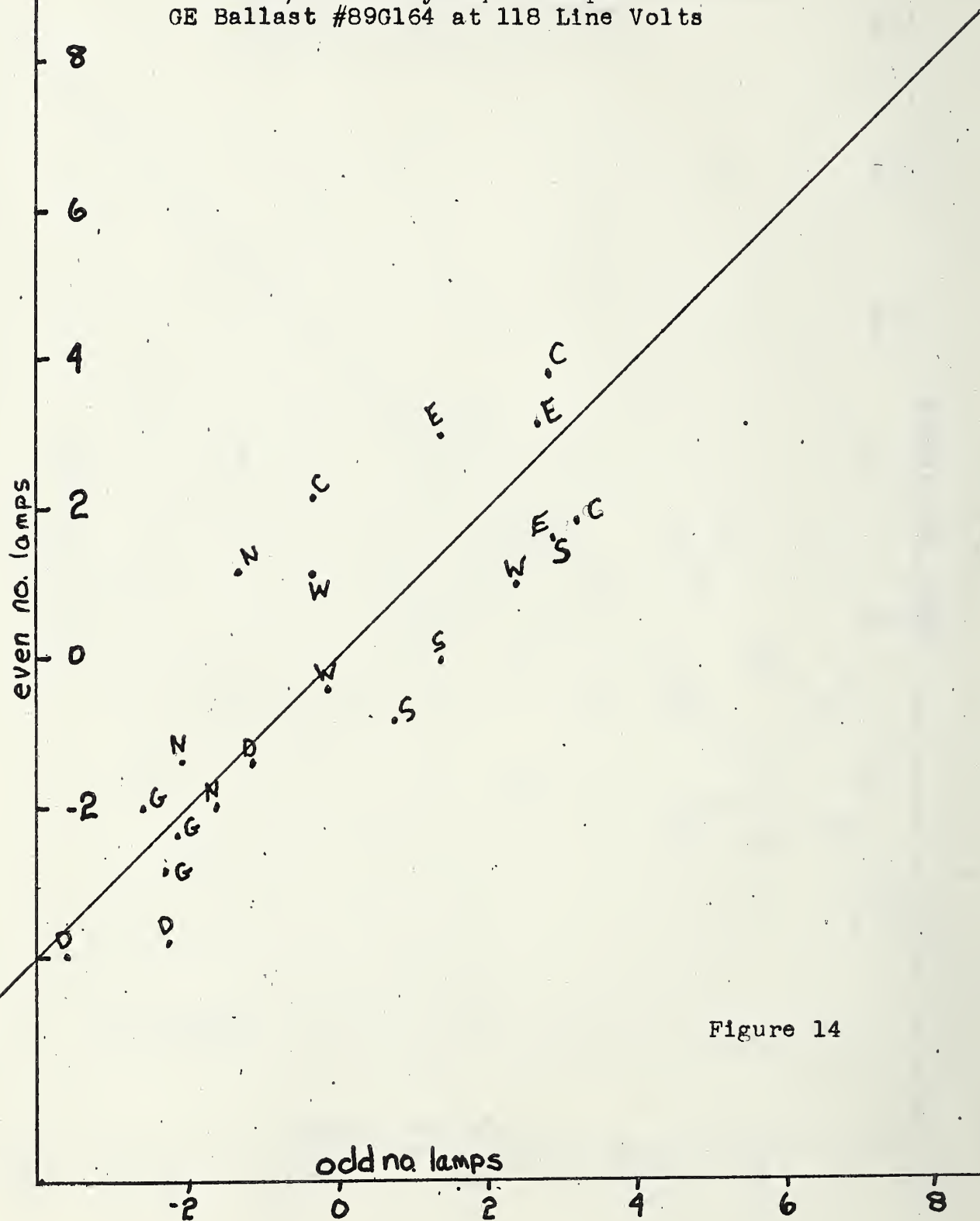


Figure 14

Lumens per Watt
Differences from the Averages
HILS Mercury Vapor Lamps
GE Ballast #89G164 at 118 Line Volts

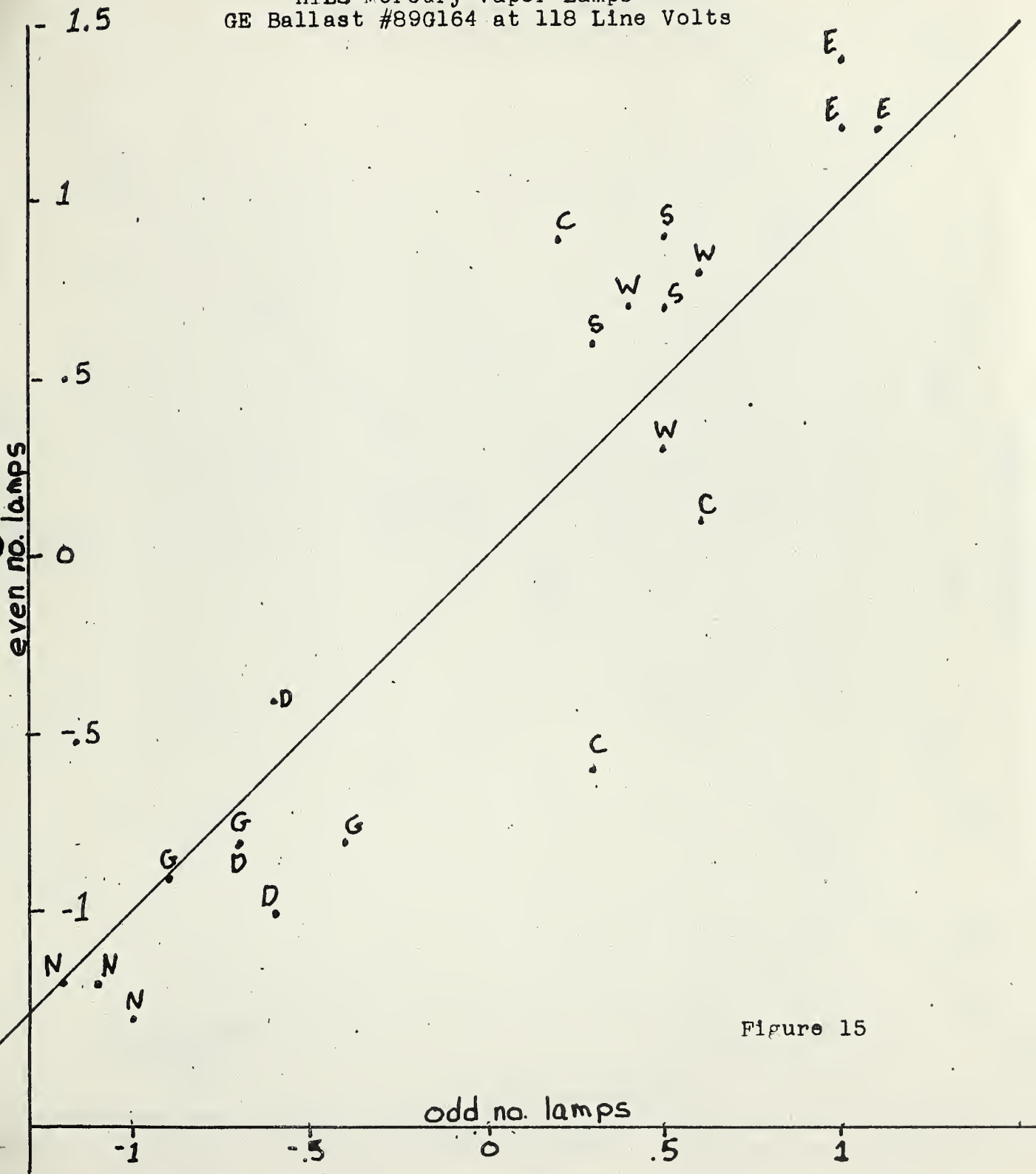


Figure 15

Lumens per Watt
Differences from the Averages
HILB/W Mercury Vapor Lamps
GE Ballast #89G164 at 118 Line Volts

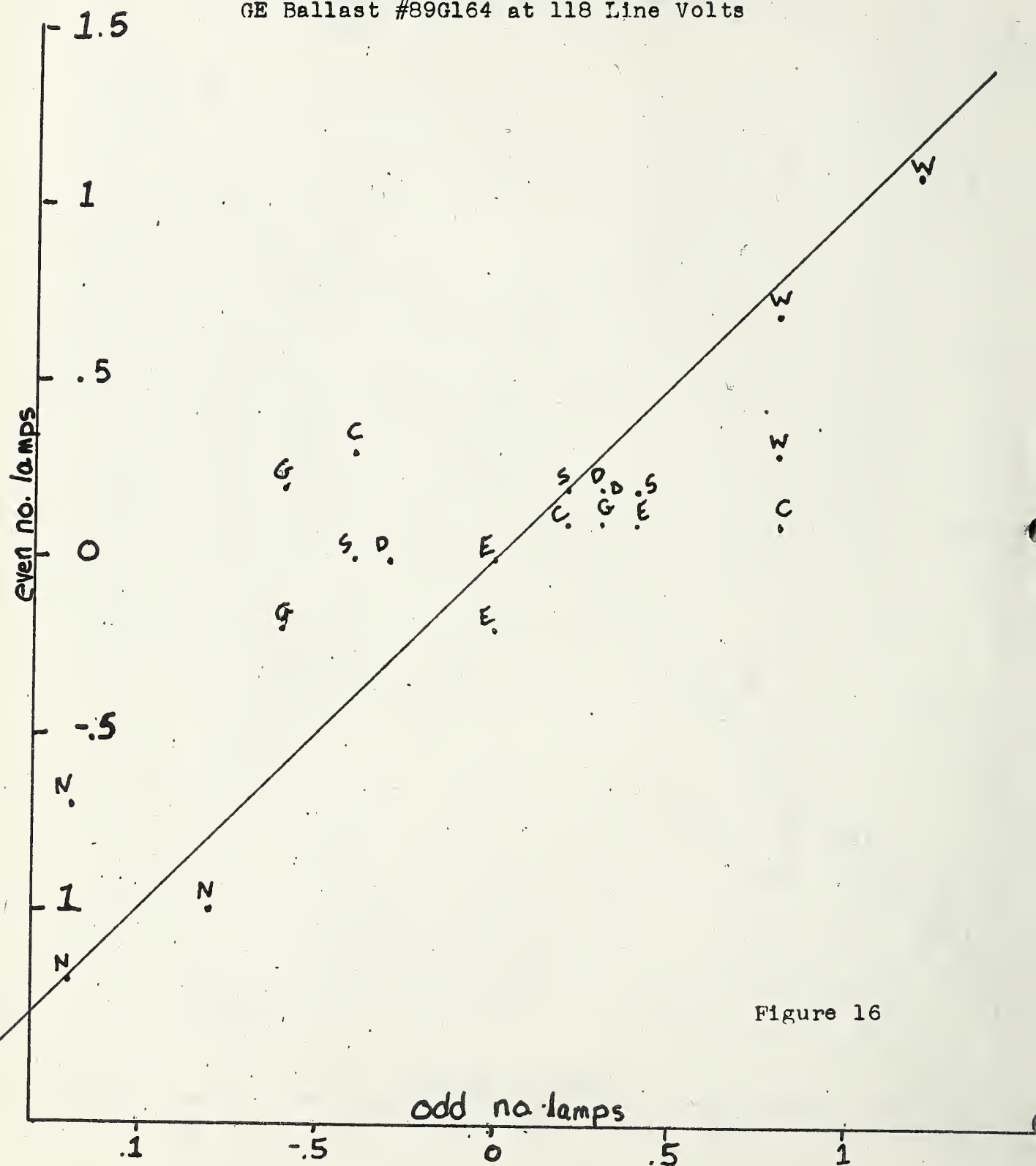


Figure 16

Lumens per Watt
Differences from the Averages
HILS Mercury Vapor Lamps
GE Ballasts #89G164 at 400 Watts

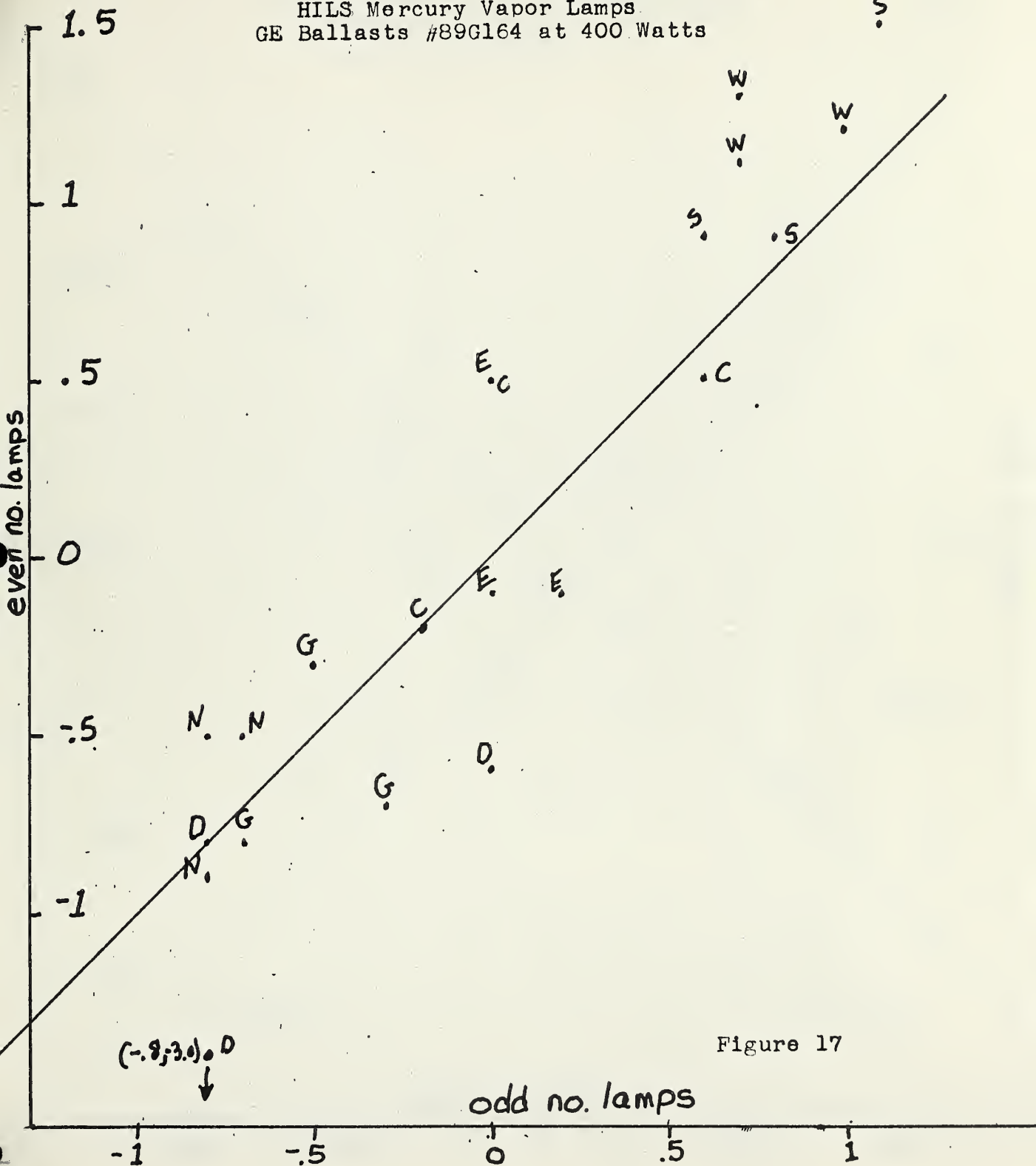


Figure 17

Lumens per Watt
Differences from the Averages
HILB/W Mercury Vapor Lamps
GE Ballast #89G164 at 400 Watts

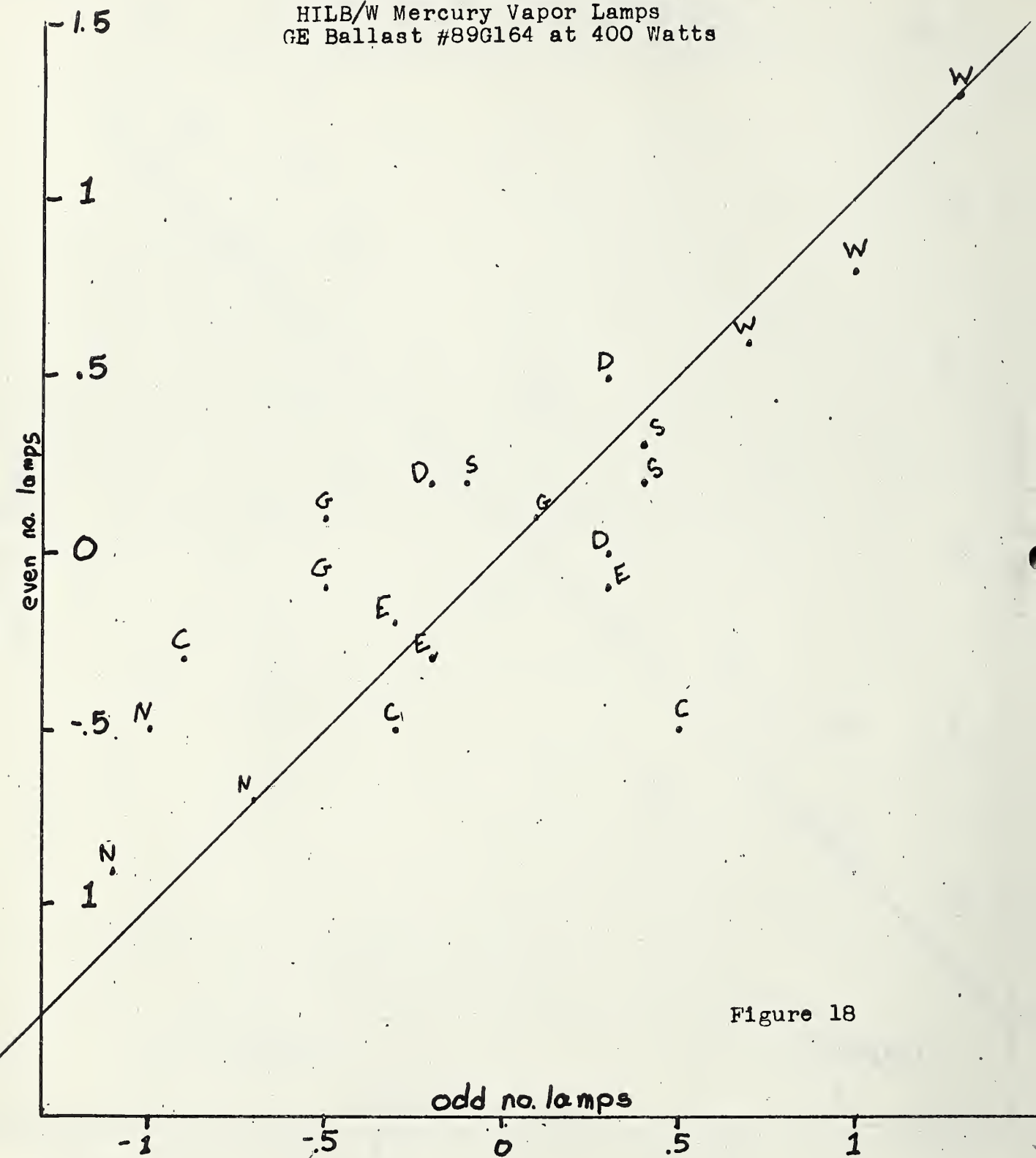


Figure 18

Lumens
Differences from the Averages
HILS Mercury Vapor Lamps
Reference Ballast

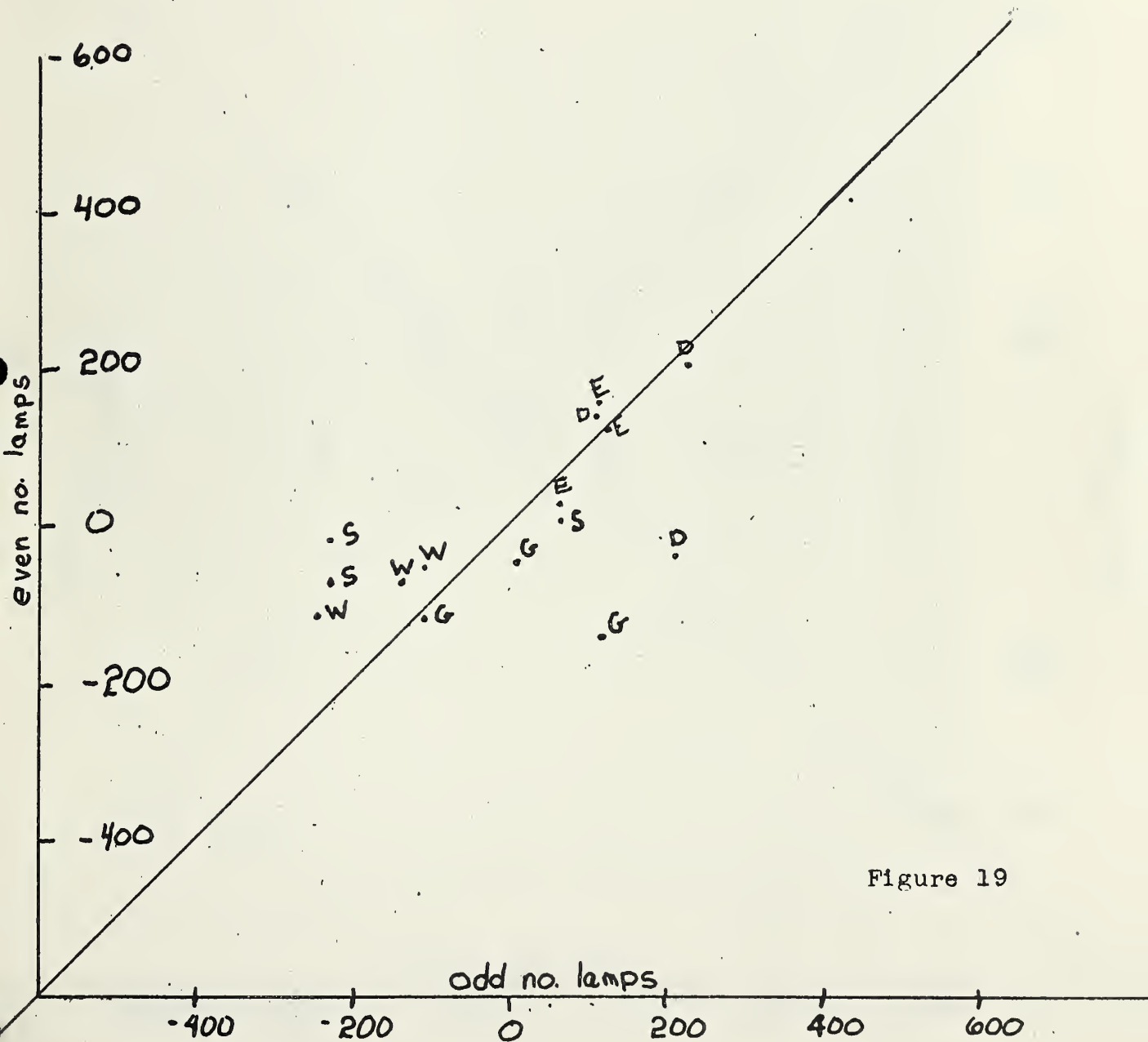


Figure 19

Lumens
Differences from the Averages
HILE/W Mercury Vapor Lamps
Reference Ballast

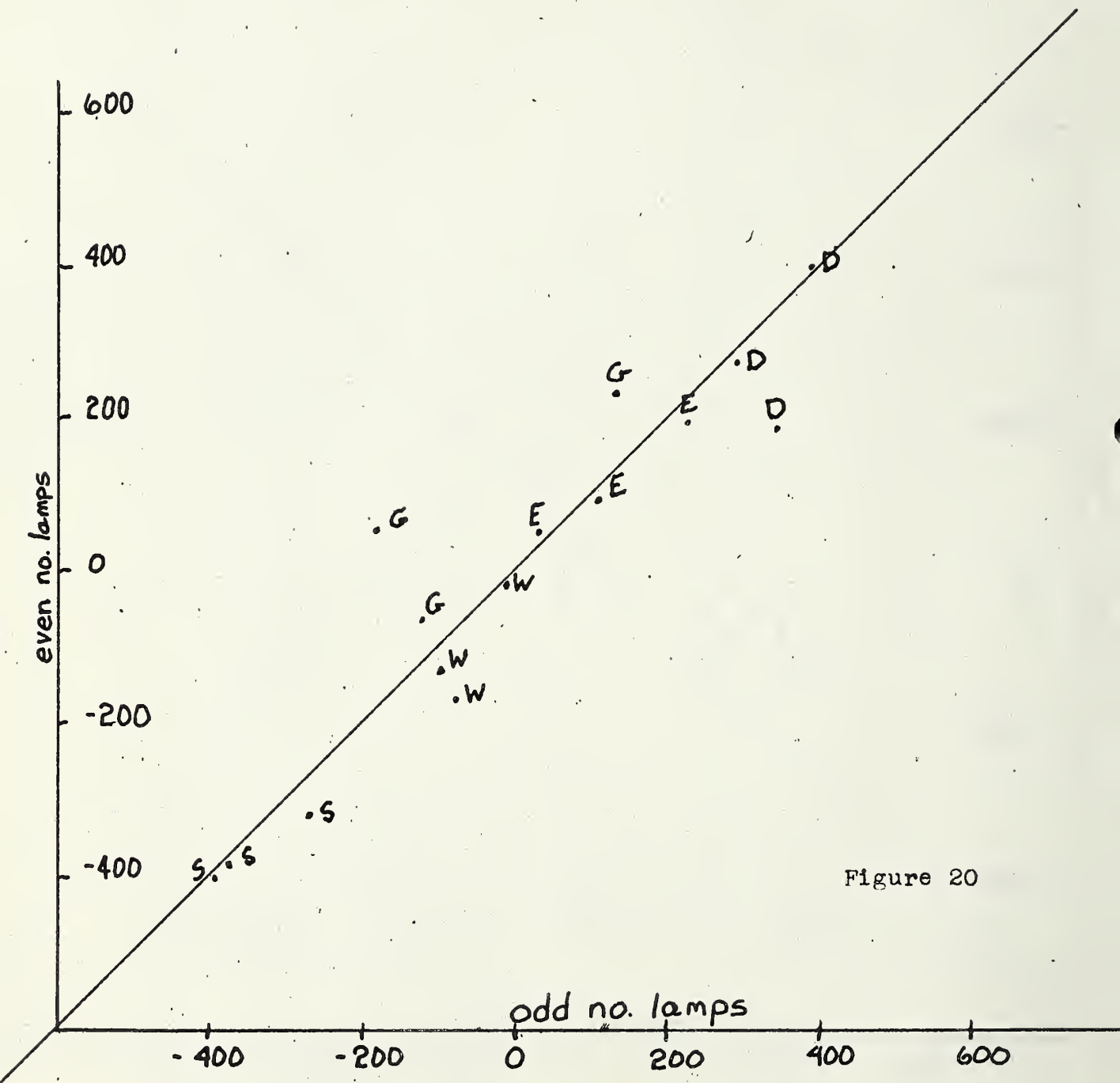


Figure 20

Lamp Volts
 Difference from the Averages
 HILS Mercury Vapor Lamps
 Reference Ballast

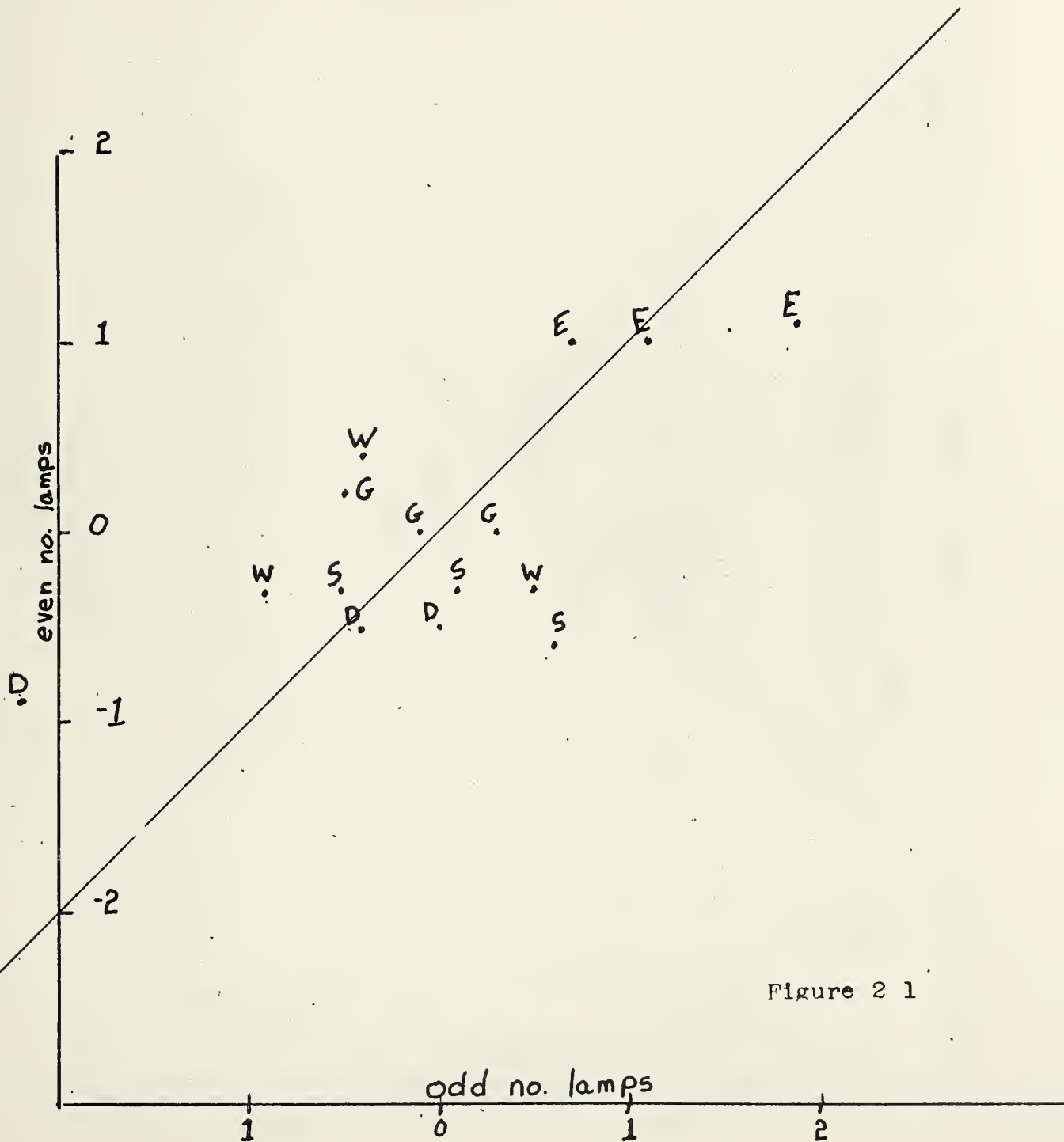


Figure 2 1

Lamp Volts
Differences from the Averages
HILB/W Mercury Vapor Lamps
Reference Ballast

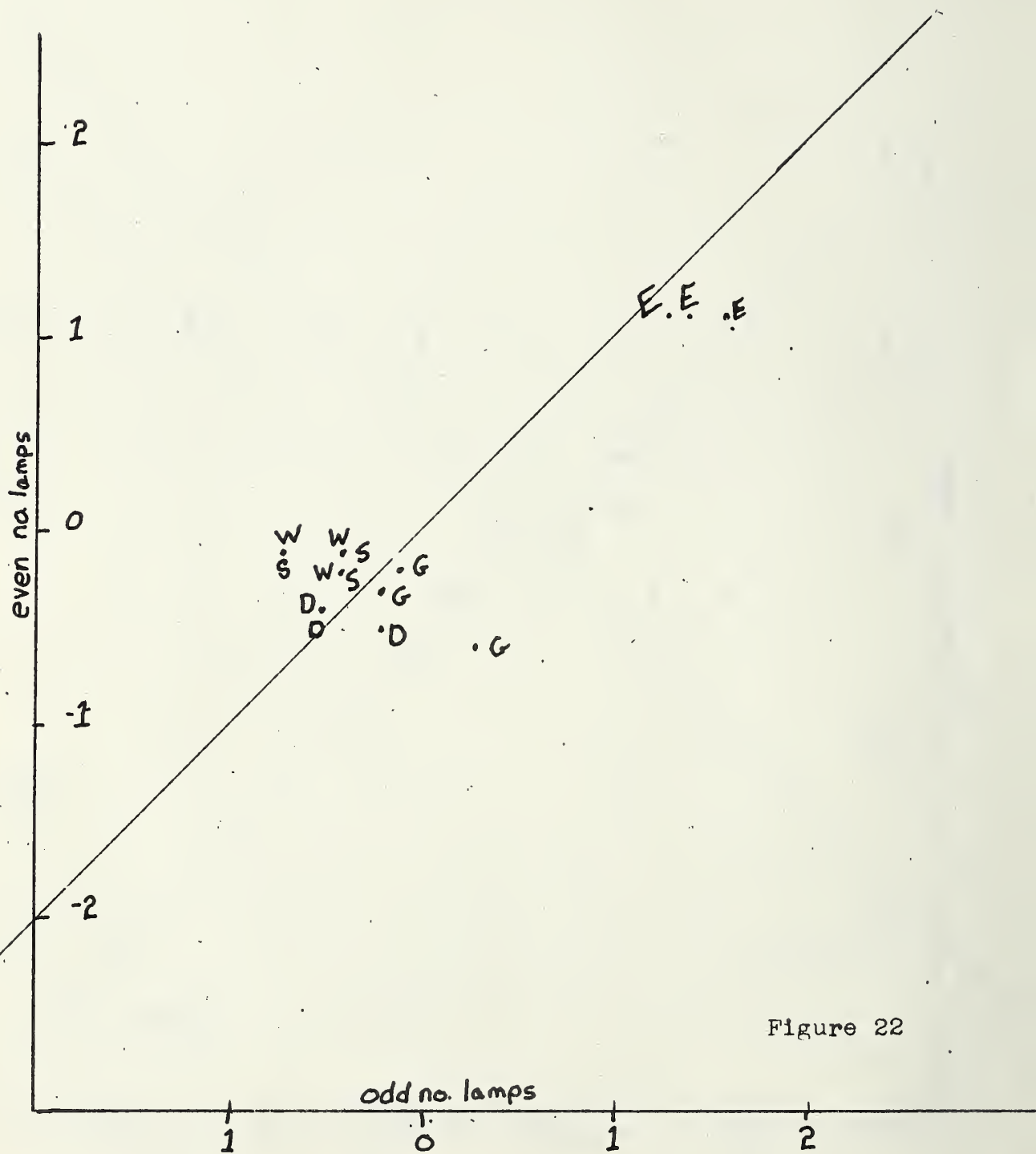


Figure 22

Amperes
Differences from the Averages
HILS Mercury Vapor Lamps
Reference Ballast

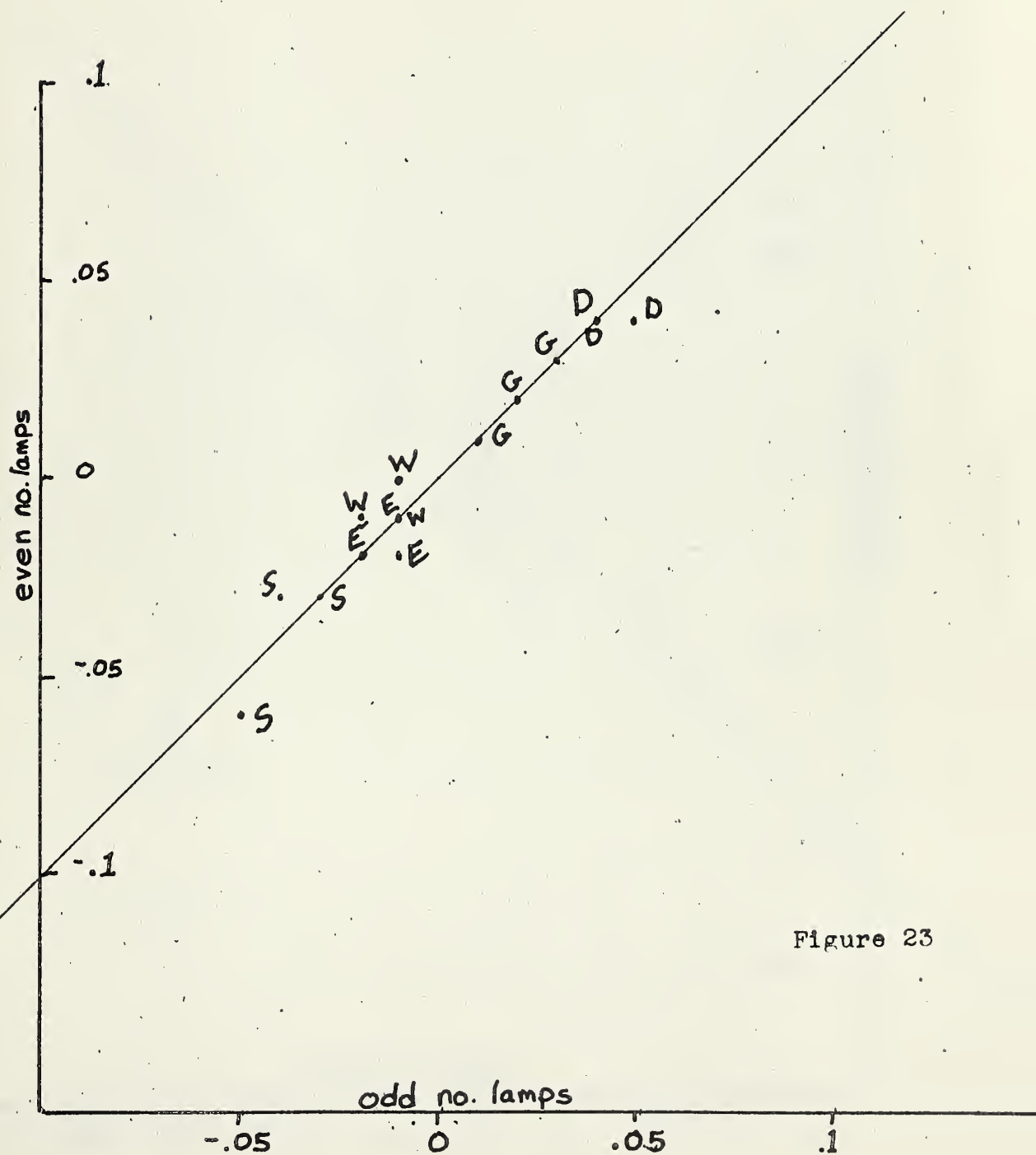


Figure 23

Amperes
Differences from the Averages
HILB/W Mercury Vapor Lamps
Reference Ballast

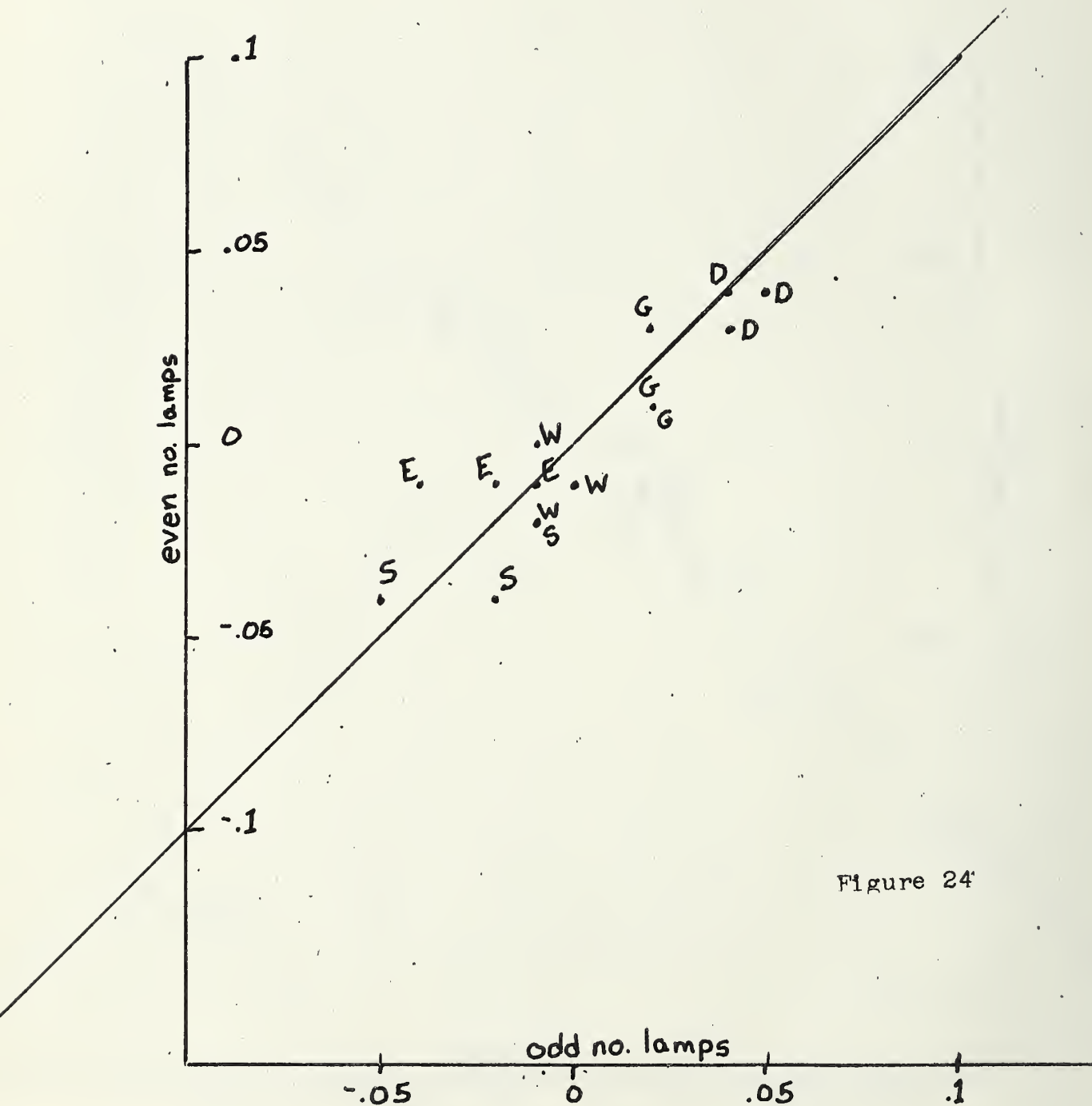


Figure 24

Watts
Differences from the Averages
HILS Mercury Vapor Lamps
Reference Ballast

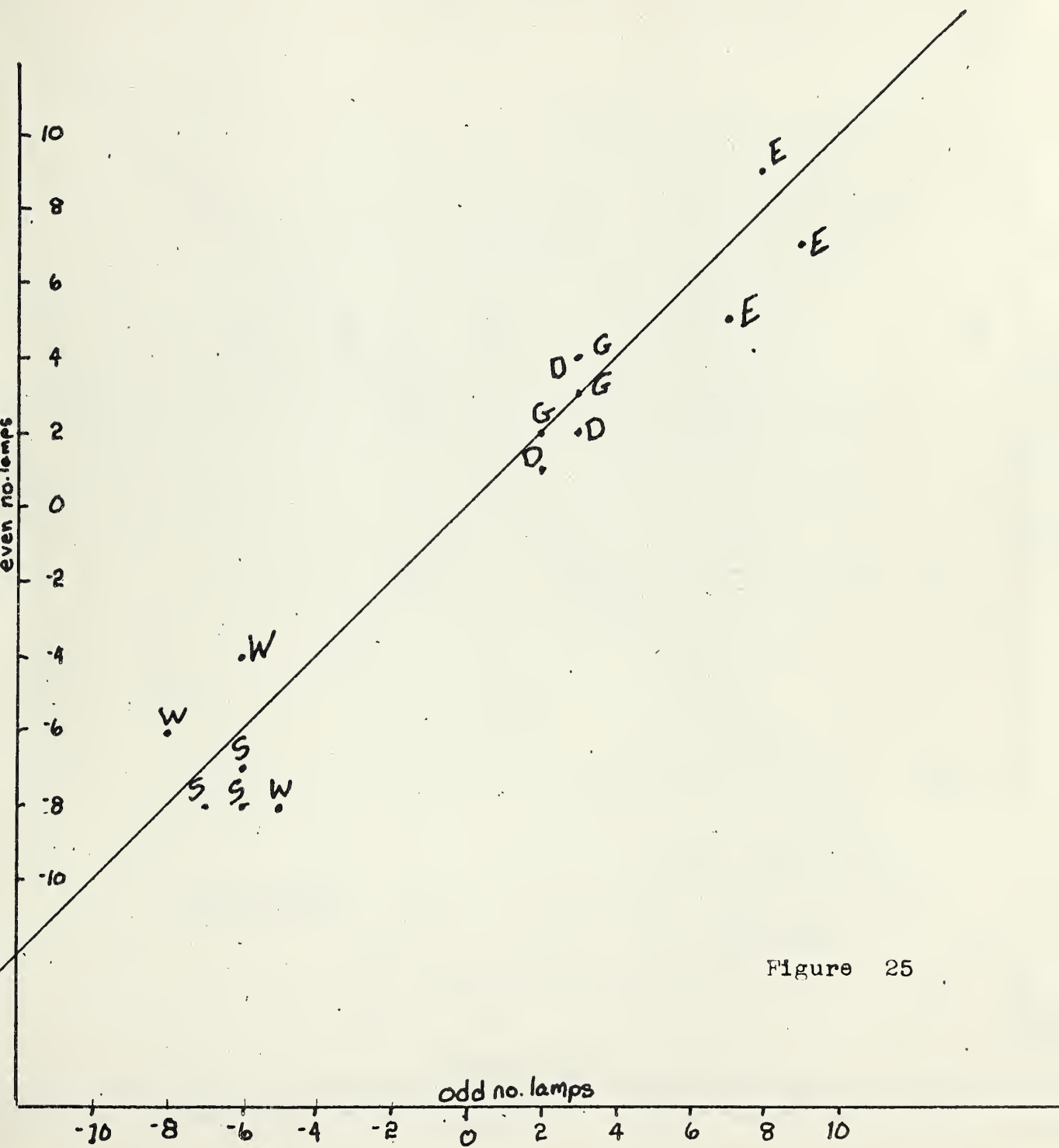


Figure 25

Watts
Differences from the Averages
HILB/W Mercury Vapor Lamps
Reference Ballast

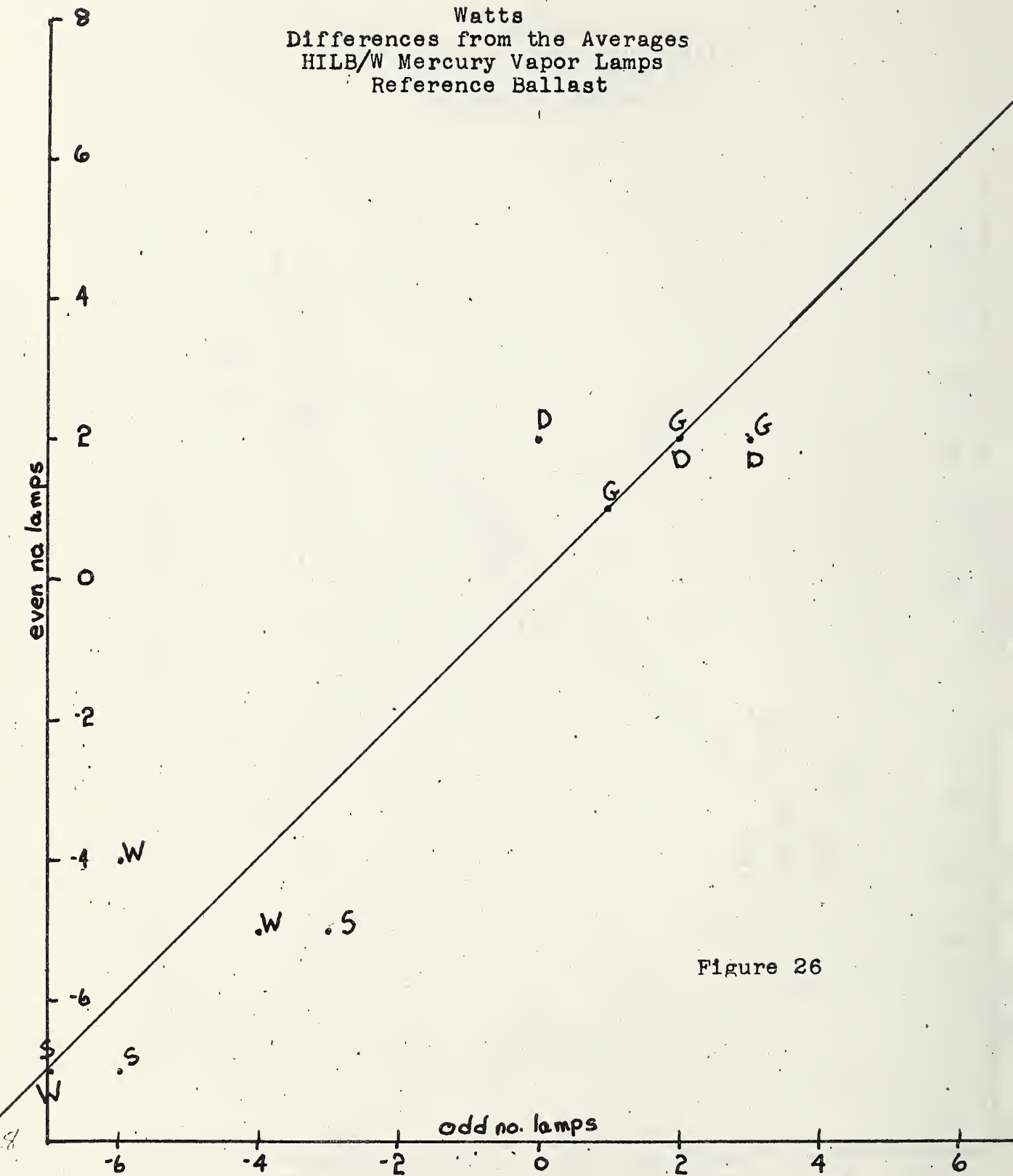


Figure 26

Lumens per Watt
Differences from the Averages
HILS Mercury Vapor Lamps
Reference Ballast

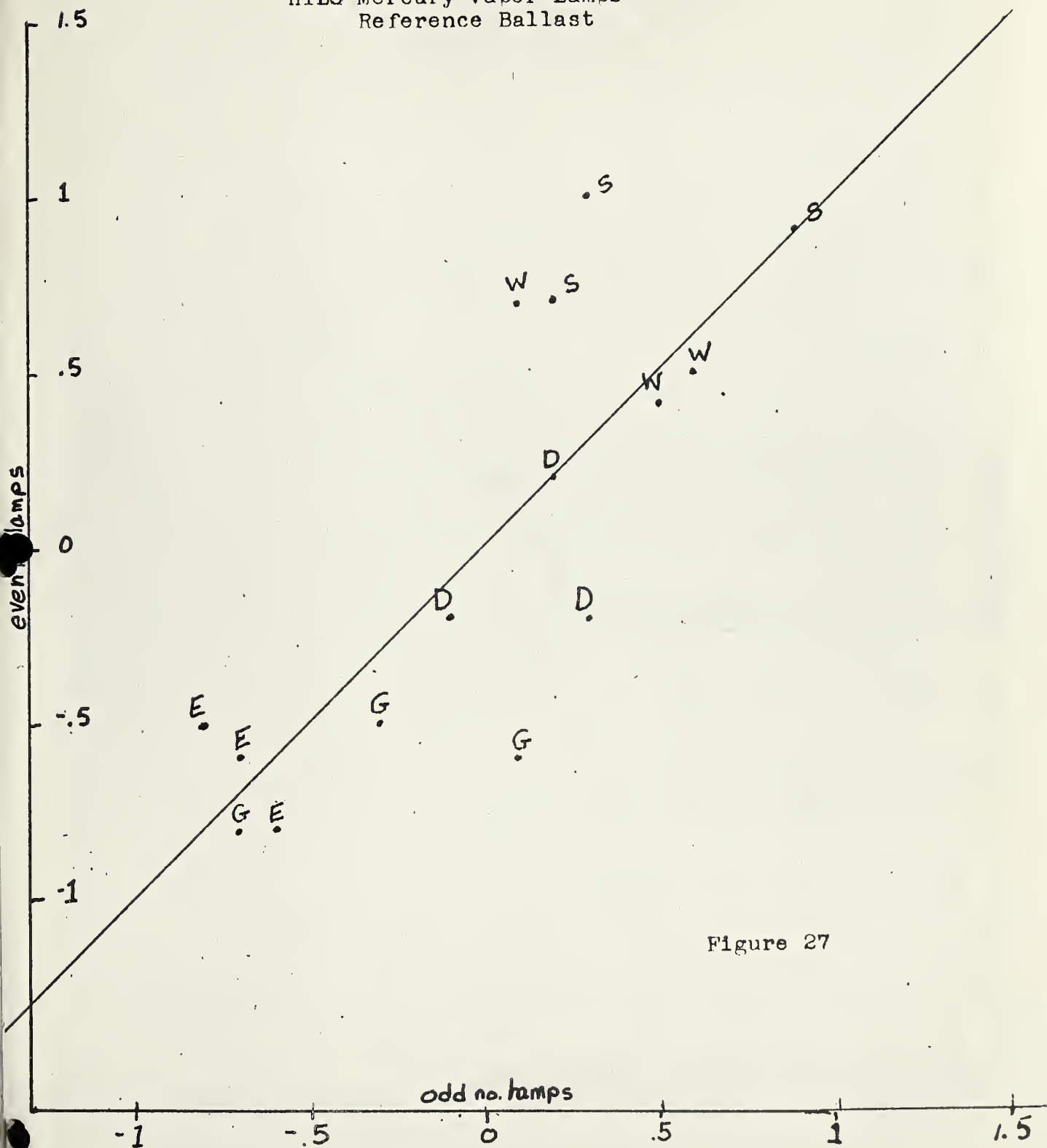


Figure 27

Lumens per Watt
Differences from the Average
HILB/W Mercury Vapor Lamps
Reference Ballast

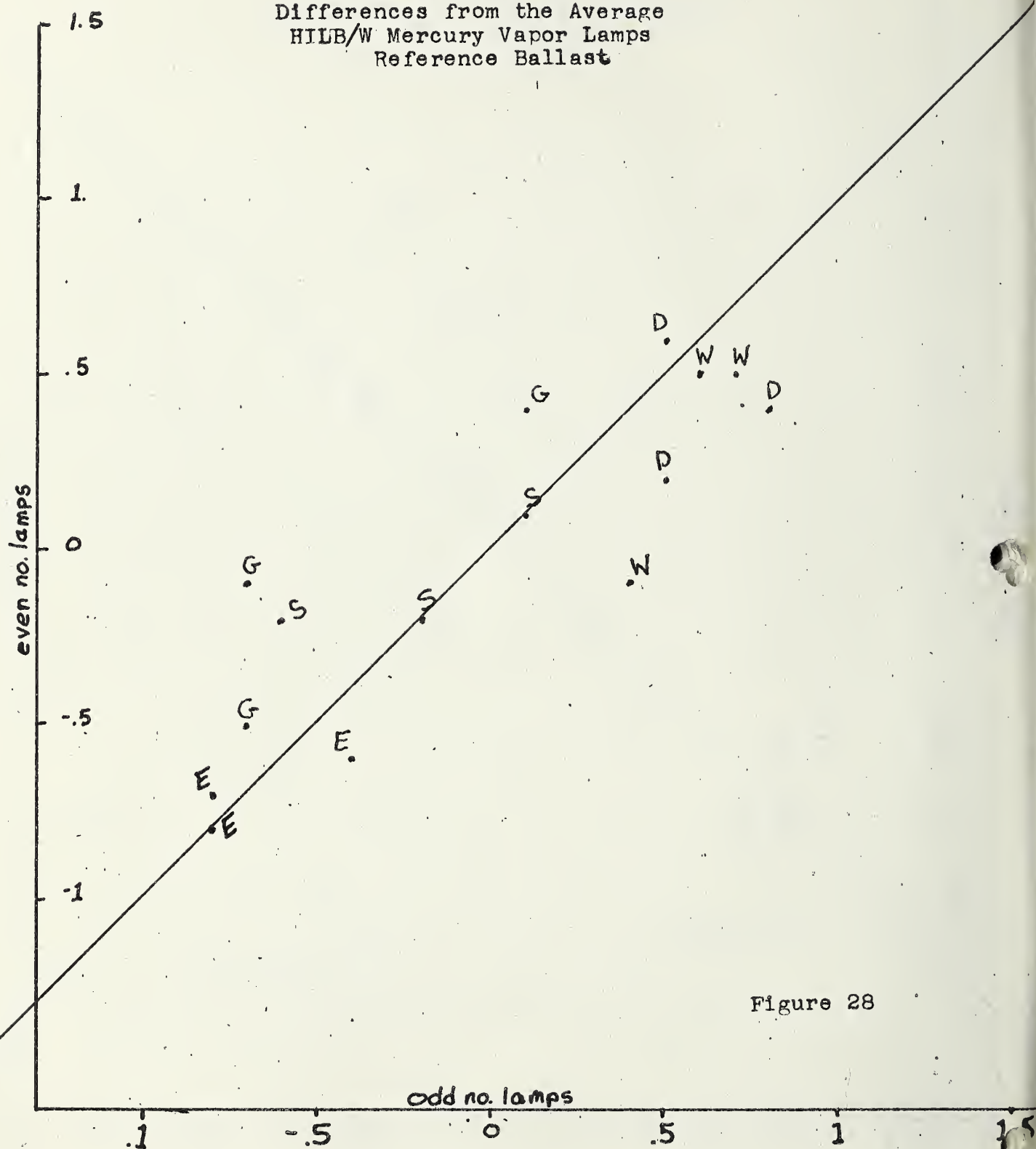


Figure 28

Lumens
HILS Mercury Vapor Lamps
GE Ballast #896164 at 118 Line Volts

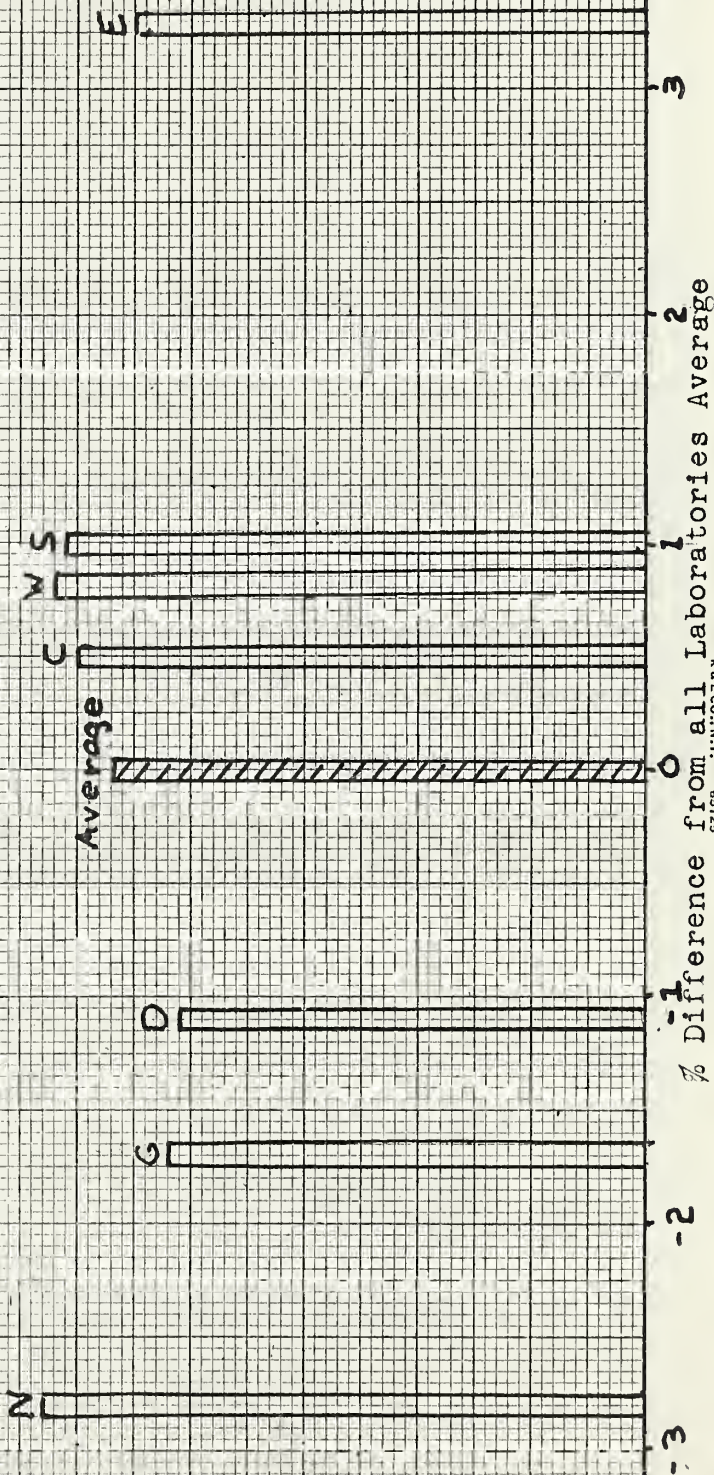
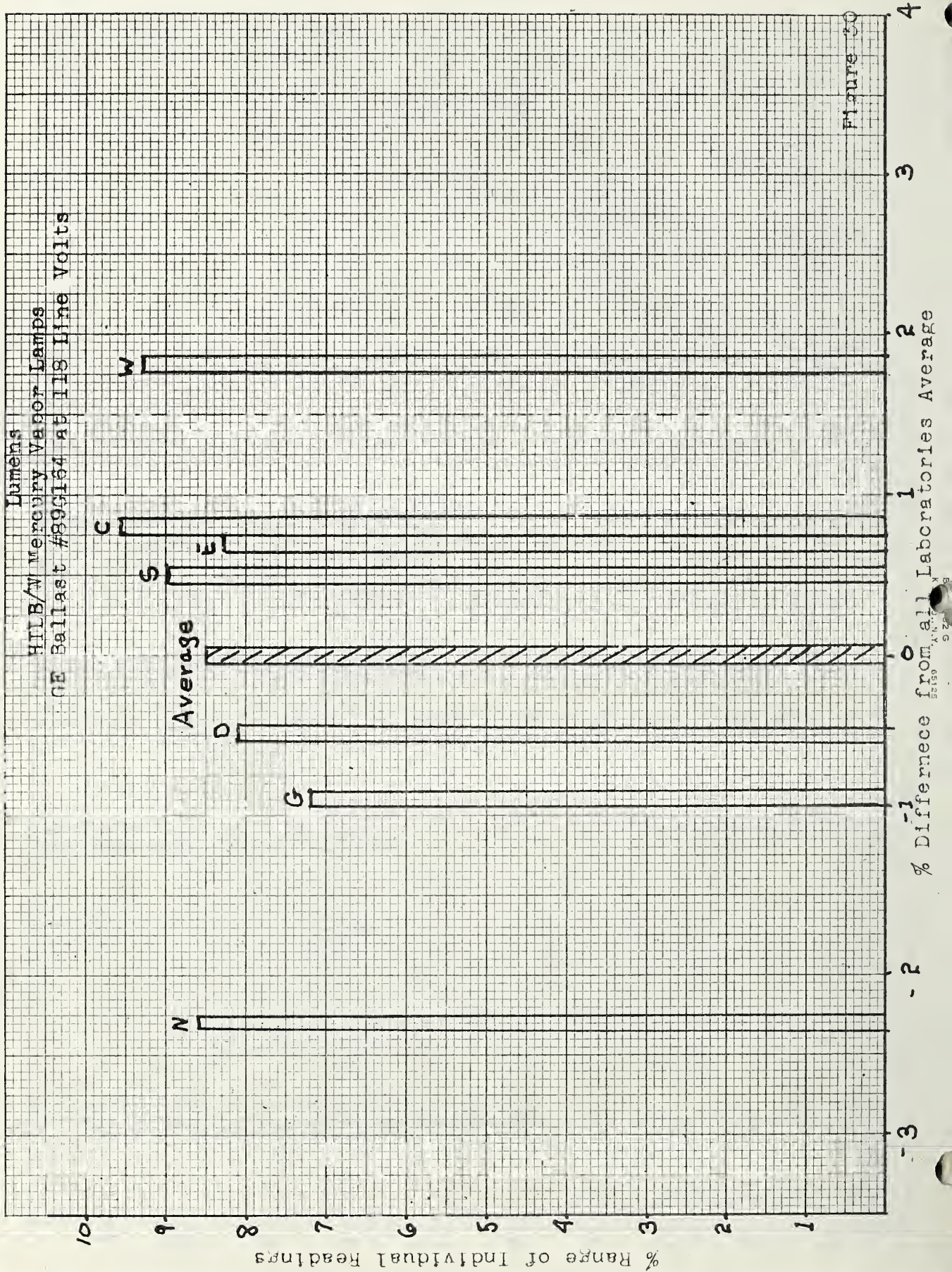


Figure 29



Lumens
 HILS Mercury Vapor Lamps
 GE Ballast #890164 at 400 Watts

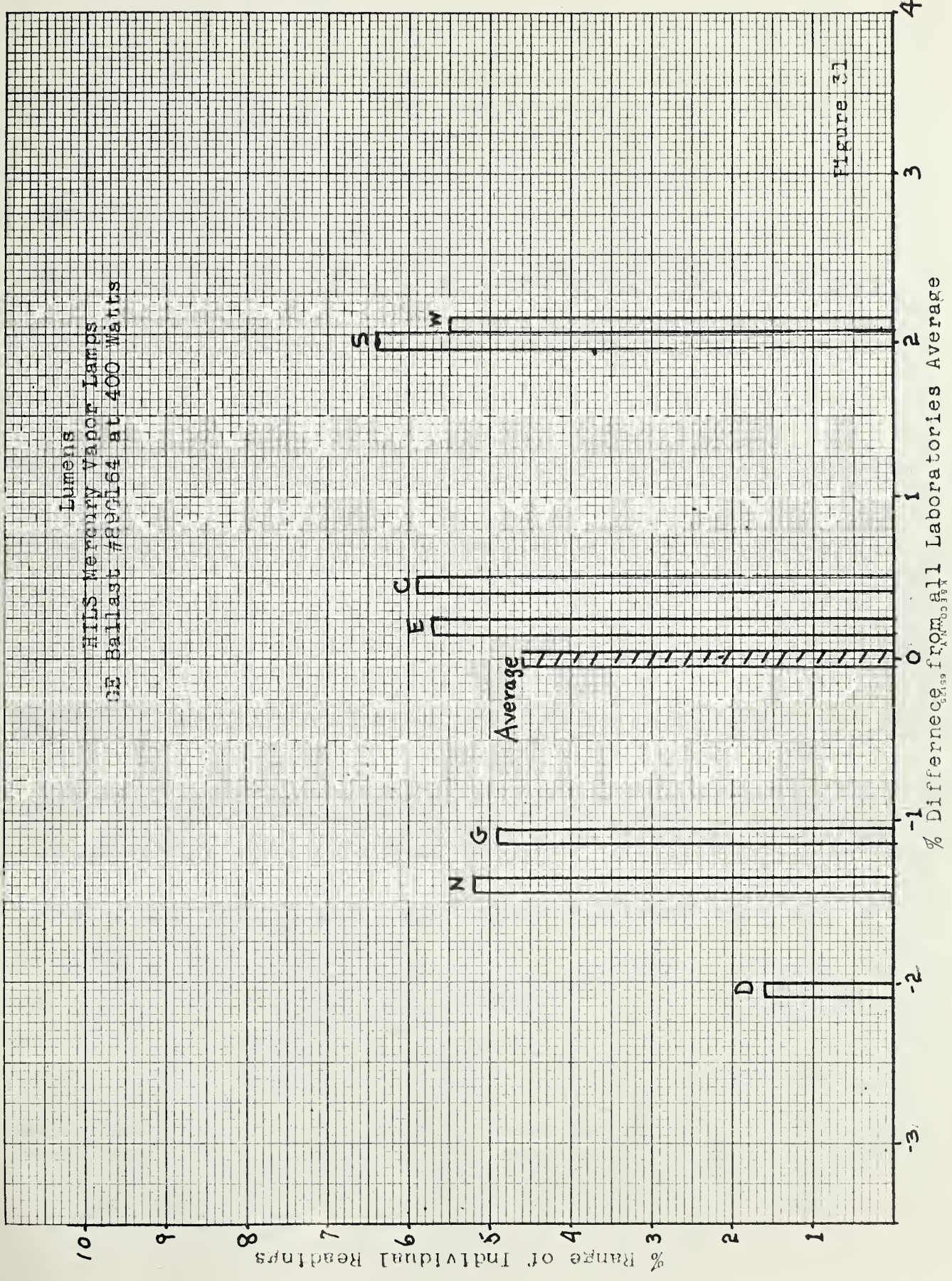


Figure 31

Lumens
 11B/W Mercury Vapor Lamps
 65 Ballast #89G164 at 400 Watts

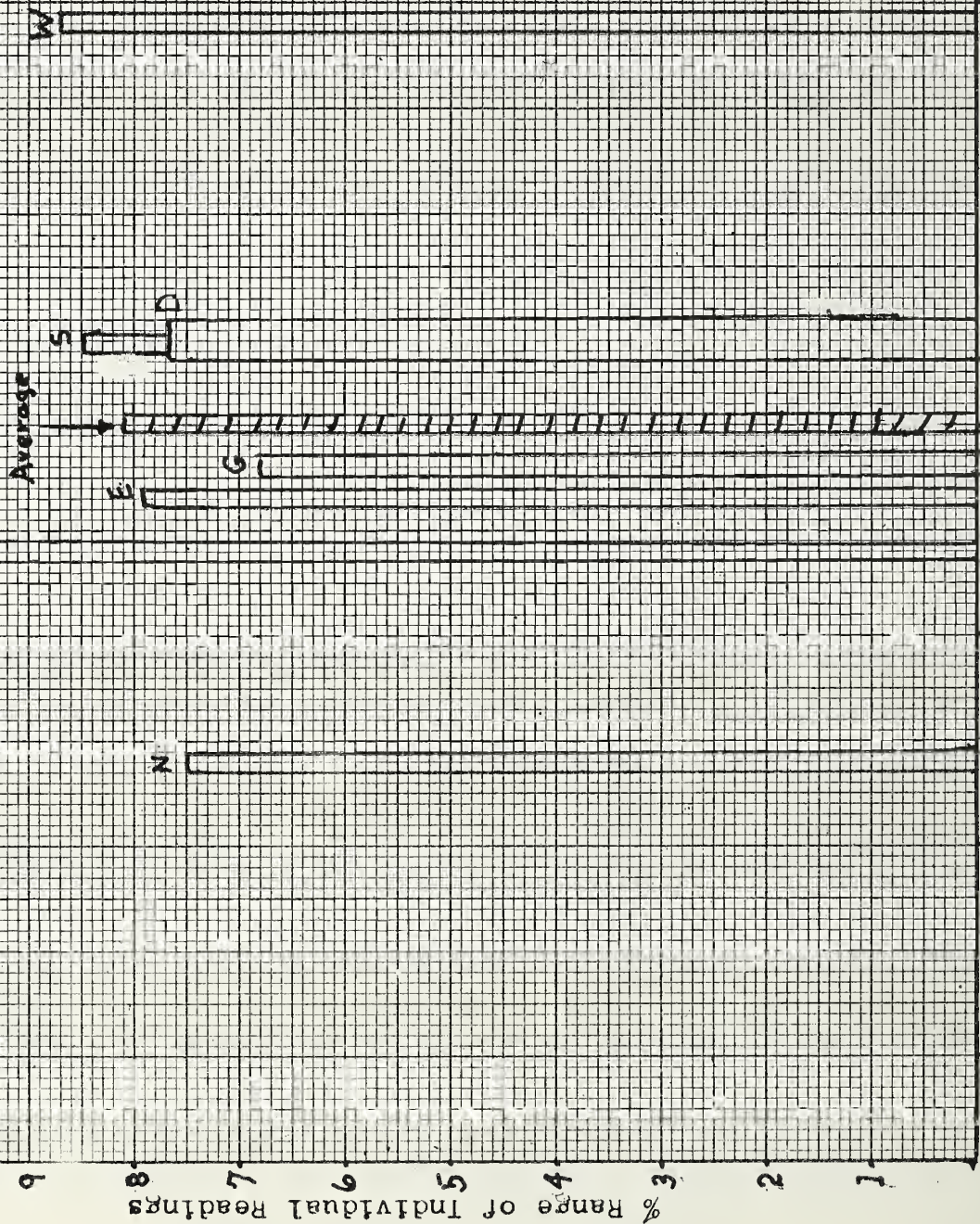


Figure 32

% Difference from all Laboratories Average

U.S. DEPARTMENT OF COMMERCE

Frederick H. Mueller, *Secretary*

NATIONAL BUREAU OF STANDARDS

A. V. Astin, *Director*



THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards at its major laboratories in Washington, D.C., and Boulder, Colorado, is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section carries out specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant publications, appears on the inside of the front cover.

WASHINGTON, D.C.

Electricity and Electronics. Resistance and Reactance. Electron Devices. Electrical Instruments. Magnetic Measurements. Dielectrics. Engineering Electronics. Electronic Instrumentation. Electrochemistry.

Optics and Metrology. Photometry and Colorimetry. Photographic Technology. Length. Engineering Metrology.

Heat. Temperature Physics. Thermodynamics. Cryogenic Physics. Rheology. Molecular Kinetics. Free Radicals Research.

Atomic and Radiation Physics. Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics. Neutron Physics. Radiation Theory. Radioactivity. X-rays. High Energy Radiation. Nucleonic Instrumentation. Radiological Equipment.

Chemistry. Organic Coatings. Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electrodeposition. Molecular Structure and Properties of Gases. Physical Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

Mechanics. Sound. Mechanical Instruments. Fluid Mechanics. Engineering Mechanics. Mass and Scale. Capacity, Density, and Fluid Meters. Combustion Controls.

Organic and Fibrous Materials. Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Plastics. Dental Research.

Metallurgy. Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion. Metal Physics.

Mineral Products. Engineering Ceramics. Glass. Refractories. Enameled Metals. Constitution and Microstructure.

Building Technology. Structural Engineering. Fire Protection. Air Conditioning, Heating, and Refrigeration. Floor, Roof, and Wall Coverings. Codes and Safety Standards. Heat Transfer. Concreting Materials.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics.

Data Processing Systems. SEAC Engineering Group. Components and Techniques. Digital Circuitry. Digital Systems. Analog Systems. Application Engineering.

• Office of Basic Instrumentation.

• Office of Weights and Measures.

BOULDER, COLORADO

Cryogenic Engineering. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Gas Liquefaction.

Radio Propagation Physics. Upper Atmosphere Research. Ionospheric Research. Regular Propagation Services. Sun-Earth Relationships. VLF Research. Radio Warning Services. Airglow and Aurora. Radio Astronomy and Arctic Propagation.

Radio Propagation Engineering. Data Reduction Instrumentation. Modulation Research. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Propagation Obstacles Engineering. Radio-Meteorology. Lower Atmosphere Physics.

Radio Standards. High Frequency Electrical Standards. Radio Broadcast Service. High Frequency Impedance Standards. Electronic Calibration Center. Microwave Physics. Microwave Circuit Standards.

Radio Communication and Systems. Low Frequency and Very Low Frequency Research. High Frequency and Very High Frequency Research. Ultra High Frequency and Super High Frequency Research. Modulation Research. Antenna Research. Navigation Systems. Systems Analysis. Field Operations.

